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Popular Master Guide

CUET-UG

Common University Entrance Test for Under Graduate Programmes

General Test

Section-III

Useful for Admission into UG Courses offered by Various Universities

Conducted by NATIONAL TESTING AGENCY (NTA)

Key Features:

- According to Latest Syllabus of Exam
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PATTERN OF EXAMINATION

SECTION-III GENERAL TEST

No. of Questions	Subject	Time
60 Questions to be attempted out of 75	Input text can be used for MCQ Based Questions General Knowledge, Current Affairs, General Mental Ability, Numerical Ability, Quantitative Reasoning (Simple application of basic mathematical concepts—Arithmetic/Algebra/Geometry/ Mensuration/Stat taught till Grade 8), Logical and Analytical Reasoning.	60 minutes

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NON-VERBAL—Series/Figural Series—*Missing Series; Figural Series;* Semantic Classification; Figural Analogy; Spatial Visualization; Space Visualization; Pinch Hole/Paper Folding & Unfolding; Figural Pattern Folding and Completion; Visual Memory; Discrimination; Embedded Figures.

■ **Numerical Ability 1-96**

Numbers System—*Whole Numbers; Decimal Fraction; Relation Between Numbers;* Comparing Quantities—*Percentage; Discount; Profit & Loss; Simple Interest; Compound Interest;* Ratio and Proportion; Algebra; Basic Algebraic Identities of School Algebra & Elementary Surds; Graphs of Linear Equations; Average; Partnership Business; Mixture and Alligation; Time and Distance; Time and Work; Geometry—*Triangle and Its Various Kinds of Centres; Congruence and Similarity of Triangles; Circle and Its Chord; Tangent;* Mensuration—*Triangle, Quadrilaterals, Regular Polygons; Prism; Right Circular Cone; Right Circular Cylinder; Sphere; Hemisphere; Right Pyramid; Rectangular Parallelepiped;* Trigonometry—*Trigonometrical Ratios; Degree and Radian Measures; Standard Identities; Complementary Angles; Heights and Distance;* Data Handling—*Histogram; Frequency Polygon; Bar Diagram & Pie-Chart.*

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SAMPLE PAPER-1 (SOLVED)

CUET-UG

(Common University Entrance Test for UG Programmes)

GENERAL TEST (SECTION-III)*

GENERAL MENTAL ABILITY/QUANTITATIVE REASONING

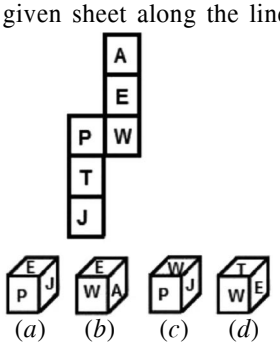
1. In a certain code language, 'SURROUND' is written as 'RRUSDNUO'. How will 'MITIGATE' be written in that language?

A. ITIMETGA B. TIIMTEAG
C. ITIEMTAG D. ITIMETAG

2. In a certain code language, 'NOSTALGIA' is coded as '81'. How will 'FRICTION' be coded in that language?

A. 105 B. 85
C. 36 D. 64

3. Select the cube(s) that can be formed by folding the given sheet along the lines.



A. Only (*a*) and (*c*) B. Only (*c*) and (*d*)
C. Only (*a*) and (*d*) D. No figure can be formed

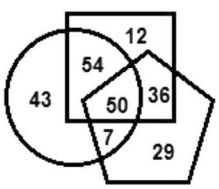
4. Read the given statements and conclusions carefully. Assuming that the information given in the statements is true, even if it appears to be at variance with commonly known facts, decide which of the given conclusions logically follow(s) from the statements.

Statements : All dustbins are plastic items.
No plastic item is stone.
All woods are stones.

Conclusions : I. No dustbin is wood.
II. No plastic item is wood.
III. Some woods may be dustbins.

A. All the conclusions follow
B. Only conclusion II follows
C. Only conclusions I and II follow
D. Only conclusion I follows

5. In the following Venn diagram, the square stands for 'Doctors', the circle stands for 'Blood donators', and the pentagon stands for 'Women'. The given numbers represent the number of persons in that particular category.



How many women doctors are blood donators?

A. 57 B. 54
C. 50 D. 36

6. Select the letter-cluster from among the given options that can replace the question mark (?) in the following series.

NZK, MBH, LDE, KFB, ?

A. HIY B. JHZ
C. JHY D. JHX

7. Select the option in which the numbers are related in the same way as are the numbers of the following set.

(18, 24, 144)

A. (22, 18, 246) B. (26, 15, 130)
C. (16, 12, 109) D. (18, 20, 137)

8. Which two numbers should be interchanged to make the given equation correct?

$78 \div 48 \times 8 + (26 \times 7) - 39 + (45 + 15) = 210$

A. 78 and 45 B. 45 and 48
C. 48 and 39 D. 26 and 15

9. Select the option that is related to the fourth number in the same way as the first number is related to the second number and the fifth number is related to the sixth number.

83 : 3 :: ? : 5 :: 258 : 4

*60 Questions to be attempted out of 75

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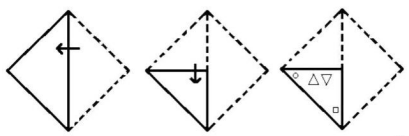
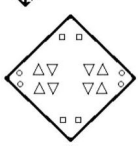
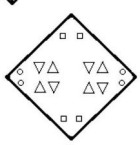
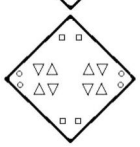
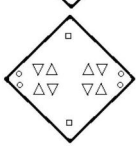
A. 527 B. 627
C. 123 D. 222

10. If 'A # B' means 'A is the sister of B' and 'A @ B' means 'A is the mother of B', then which of the following expressions means 'C is the mother of F'?
A. H @ C # M # F B. C @ H # M @ F
C. F @ H # M # C D. C @ H # M # F

11. The sequence of folding a piece of paper and the manner in which the folded paper has been cut is shown in the following figures. How would this paper look when unfolded?



A.  B. 
C.  D. 

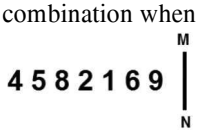
12. Select the option that is embedded in the given figure (rotation is NOT allowed).

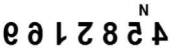
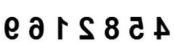
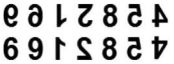
A. B.
C. D.

13. Four letter-clusters have been given, out of which three are alike in some manner and one is different. Select the letter-cluster that is different.
A. TXCZ B. DHSP
C. FJQN D. NRJG

14. Select the option in which the numbers are related in the same way as are the numbers of the following set.
(5, 11, 275)
A. (6, 18, 180) B. (9, 15, 270)
C. (8, 14, 490) D. (4, 16, 256)

15. Select the correct mirror image of the given combination when the mirror is placed at MN as shown.



A.  B. 
C.  D.

16. Select the option in which the words share the same relationship as that shared by the given pair of words.
Mauritius : Port Louis
A. Zambia : Harare B. Sudan : Tanzania
C. Nigeria : Senegal D. Kenya : Nairobi

17. Select the option that is related to the third word in the same way as the second word is related to the first word.
Conceit : Modesty : : Despair : ?
A. Hope B. Gloom
C. Anguish D. Pain

18. Four words have been given, out of which three are alike in some manner and one is different. Select the word that is different.
A. Cardiologists B. Nephrologists
C. Pulmonologists D. Psychiatrists

19. Select the combination of letters that when sequentially placed in the blanks of the given series will complete the series.
K _ C T Q _ O C _ _ K O _ T _ K O _ T T
A. O, K, T, R, C, T, C B. P, K, T, R, C, S, C
C. O, K, U, R, C, S, C D. O, K, T, R, C, S, C

20. What was the day of the week on 10 June, 2011?
A. Saturday B. Friday
C. Sunday D. Monday

Directions (Qs. No. 21-25): *Following is an array of questions to test your reasoning ability in different situations. Answer each of them according to the question asked in each of them respectively:*

21. If highways were restricted to cars and only those trucks with capacity of less than 8 tons, most of the truck traffic would be forced to run outside highways. Such a reduction in the amount of truck traffic would reduce the risk of collisions on highways. The conclusion drawn in the first sentence depends on which of the following assumptions?
A. The roads outside highway would be as convenient as highway for most drivers of trucks.
B. Most of the roads outside highways are not ready to handle truck traffic.
C. Most trucks that are currently running in highway have a capacity of more than 8 tons.
D. Cars are at greater risk of being involved in collisions than are trucks.

22. Read the debate between Harry and Potter and identify the main issue:

Harry: Within democracies, voters are entitled to know the down-side to a candidate and the other side is obviously well placed to voice it. To stifle one's ability to voice negative things about a candidate would be to obstruct democracy and limit free speech.

Potter: Negative advertisements produce the politics of the personal, since an easiest advert is an attack-advert which focuses on the personality or personal qualities of one's opponent. A negative advertisement is one that focuses upon a rival product, in this case,

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a rival election candidate or party in order to point its flaws and to persuade the public to not vote for it.

A. Whether negative advertisement strengthens democratic governance?
B. Whether the practice of negative advertisements is good for democracy and politics?
C. Whether negative advertising needs to be banned?
D. Whether negative advertising produces the politics of the personal?

23. Which alternative applies to the following Statement and Assumption?

Statement: Go by Aeroplane to reach Delhi from Chennai quickly.

Assumptions:

I. Chennai and Delhi are connected by Air service.
II. There is no other means to commute from Chennai to Delhi.
III. The Air distance between Delhi and Chennai is less.

A. Only I is implicit.
B. Only I and II are implicit.
C. Only I and III are implicit.
D. Only II is implicit.

24. Ananya and Krishna can speak and follow English. Bulbul can write and speak Hindi as Archana does. Archana talks with Ananya also in Bengali. Krishna cannot follow Bengali. Bulbul talks with Ananya in Hindi. Who can speak and follow English, Hindi and Bengali?

A. Archana B. Bulbul
C. Krishna D. Ananya

25. If '367' means 'I am happy'; '748' means 'you are sad' and '469' means 'happy and sad' in a given code, then which of the following represents and in the code?

A. 3 B. 6
C. 9 D. 4

GENERAL KNOWLEDGE

26. The _____ sultanate was ruled by the Sharqi dynasty.

A. Bharatpur B. Agra
C. Jaunpur D. Delhi

27. Birju Maharaj, a classical dancer of world repute, died on January 17, 2022. He was exponent of:

A. Bharatnattyam B. Odishi
C. Kathakali D. Kathak

28. Parsec is a unit of _____.

A. acceleration B. speed
C. time D. length

29. Which of the following is the SI unit for measuring the amount of a substance?

A. metre (m) B. kelvin (K)
C. mole (mol) D. candela (cd)

30. The Kamaicha is a bowed lute played by the Manganiars of:

A. west Rajasthan B. west Goa
C. west Bihar D. west Kerala

31. The archaeological site of Atranjikhera is located in _____.

A. Uttarakhand
B. Uttar Pradesh
C. Maharashtra
D. Himachal Pradesh

32. In 1977, who became the President of the Janata Party, which formed a coalition government at the centre with Morarji Desai as the Prime Minister?

A. Charan Singh
B. Madhu Dandavate
C. George Fernandes
D. Chandra Shekhar

33. Who become Miss World 2021 in March 2022?

A. Shree Saini
B. Olivia Yace
C. Mansa Varanasi
D. Karolina Bielawaska

34. With which of the following sports do you associate the term '16-yard hit'?

A. Field hockey B. Cricket
C. Lawn tennis D. Golf

35. Atoms of which element combines with hydrogen to give water?

A. Carbon B. Oxygen
C. Iodine D. Nitrogen

36. The Arjuna Awards are given by the Ministry of Youth Affairs and Sports to recognise outstanding achievement in sports and games. It was instituted in _____.

A. 1947 B. 1961
C. 1969 D. 1956

37. Who become new Chief Minister of Punjab?

A. Bhagwant Mann
B. Sukhbir Singh Badal
C. Amrinder Singh
D. Bhupendra Singh

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38. With which of the following states does Bangladesh NOT share its border?
A. Meghalaya B. Assam
C. Nagaland D. Tripura

39. Who is the author of the book, 'Men in White — A Book of Cricket'?
A. Sanjay Manjrekar
B. Mukul Kesavan
C. Harsha Bhogle
D. Boria Mazumdar

40. The rules made for the _____ were written down in a book called 'Vinaya Pitaka'.
A. Vaishnavites B. Buddhist sangha
C. Lingayats D. Shakta cult

41. Which of the following is a district-cum-tourism hotspot of Arunachal Pradesh?
A. Alipurduar B. Jalpaiguri
C. Kalimpong D. Tawang

42. In connection with the issue of adoption of villages by parliamentarians, a scheme named 'SAGY' was launched. What does the 'A' in SAGY stand for?
A. Anubhav B. Atmanirbhar
C. Apna D. Adarsh

43. Weber per second is equivalent to _____.
A. ampere B. volt
C. coulomb D. ohm

44. _____ festival in the Bastar region is celebrated along with the worship of the local goddess, Kesharpal Kesharpalin Devi.
A. Phool Dei B. Harela
C. Madai D. Khatarua

45. Which of the following films won the Best Motion Picture Drama prize in the 15th 'Golden Globe Awards'?
A. Coda
B. Dune
C. King Richard
D. The Power of the Dog

Directions (Qs. No. 46-50): *Read the passage carefully and answer these questions.*

There is really nothing new, not already anticipated in a distressed planet since the emergence of human species life nearly two million years ago. So, a long prehistory of inter-faith dialogue entailing the reciprocal relation between religious traditions and the robustness of the very idea of being human and having rights, precedes the recent UN movement of faith for rights (F4R). The F4R framework has finally been affirmed by the United Nations system. The Office of the High Commissioner for Human Rights (OCHR) promoted the Rabat plan of action in 2012. Note that this happened after the end of the Cold War, during globalisation, and soon after 9/11. The plan was a result of a series of expert workshops on the prohibition of incitement to national, racial or religious hatred, underlying "legislative patterns, judicial practices and policies". The UN Human Rights Council is shortly going to discuss further the prohibition of the advocacy of national, racial or religious hatred that constitutes incitement to "discrimination, hostility or violence".

46. When was the first human rights declaration adopted by the United Nations?
A. December 10, 1945
B. September 10, 1945
C. December 10, 1948
D. September 10, 1948

47. The United Nations Human Rights Council is a/an _____ body within the United Nations System.
A. Inter-governmental
B. Non-governmental
C. Quasi-governmental
D. Multi-stakeholder

48. The Universal Declaration of Human Rights (UDHR), the International Covenant on Economic, Social and Cultural Rights (ICESCR), and the International Covenant on Civil and Political Rights (ICCPR) and its two Optional Protocols have been adopted under the auspices of the United Nations and are collectively referred to as _____.
A. Magna Carta Libertatum.
B. International Bill of Human Rights.
C. International Charter of the Rights of the Man and the Citizen.
D. International Charter of Human Rights.

49. The objective of the 'Faith for Rights' (F4R) is to provide space for a cross-disciplinary reflection and action on the deep, and mutually enriching, connections between religions and human rights. Which of the following is not one of the commitments on Faith for Rights (F4R)?
A. To prevent the use of the notion of 'State religion' to discriminate against any individual or group.
B. To revisit religious interpretations that appear to perpetuate gender inequality and harmful stereotypes or even condone gender-based violence.
C. To refine the curriculums, teaching materials and textbooks to rectify harmful stereotypes.
D. To promote religious dogmatism.

50. In India, which of the following statutory organisations is responsible for the protection and promotion of human rights?
A. National Human Rights Council.
B. National Human Rights Commission.
C. National Human Rights Organisation.
D. Indian Human Rights Council.

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NUMERICAL ABILITY

51. If $x + y + z = 1$, $xy + yz + zx = xyz = -4$, then what is the value of $(x^3 + y^3 + z^3)$?
A. 8 B. –8
C. 1 D. –1

52. What is the constant term in the expansion of $\left(5x^2 - \frac{1}{x}\right)^3$?
A. 15 B. 5
C. 75 D. –15

53. In a trapezium PQRS, PQ is parallel to RS and diagonals PR and QS intersect at O. If PQ = 4 cm, SR = 10 cm, then what is area (ΔPOQ) : area (ΔSOR)?
A. 2 : 3 B. 2 : 5
C. 4 : 25 D. 4 : 9

54. A shopkeeper buys an article at 30% discount on its marked price and sells it at 5% discount on its marked price. If he earns a profit of ₹ 65, then what is the marked price (in ₹) of the article?
A. 227.50 B. 325
C. 260 D. 292.50

55. If $\tan\theta = \sqrt{5}$, then the value of $\frac{\text{cosec}^2\theta + \sec^2\theta}{\text{cosec}^2\theta - \sec^2\theta}$ is:
A. $-\frac{7}{5}$ B. $\frac{7}{5}$
C. $-\frac{3}{2}$ D. $\frac{3}{2}$

56. A sum of ₹ 6342 is divided amongst A, B, C and D in the ratio 3 : 4 : 8 : 6. What is the difference between the shares of B and D?
A. ₹ 906 B. ₹ 1510
C. ₹ 302 D. ₹ 604

57. If $x^2 - 5\sqrt{2}x + 1 = 0$, then what is the value of $\frac{\left(x^3 + \frac{1}{x}\right)}{x^2 + 1}$?
A. $\frac{24\sqrt{2}}{5}$ B. $\frac{12\sqrt{2}}{5}$
C. $\frac{18\sqrt{2}}{5}$ D. $\frac{26\sqrt{2}}{5}$

58. Simplify the following expression:
6 ÷ 4 of 3 – 4 ÷ 6 × (13 – 10) – 2 × 15 ÷ 6 × 6
A. $-27\frac{1}{2}$ B. $-19\frac{1}{2}$
C. $-29\frac{14}{17}$ D. $-31\frac{1}{2}$

59. A sum of ₹ 3125 amounts to ₹ 3515.20 in 3 years at x % p.a., interest being compounded yearly. What will be the simple interest (in ₹) on the same sum and for the same time at $(x + 2)$% p.a.?
A. 562.50 B. 554
C. 550 D. 565.50

60. A can complete a work in 60 days. B is 25% more efficient than A. They work together for 15 days. C alone completes the remaining work in 14 days. B and C together will complete $\frac{5}{8}$ th part of the original work in:
A. 18 days
B. 15 days
C. 16 days
D. 12 days

61. By selling an article for ₹ 131.25, a trader gains as much percent as the number representing the cost price of the article. In order to earn 40% profit, at what price (in ₹) should he sell the article?
A. 140 B. 105
C. 75 D. 100

62. The cost of tiling the floor of a rectangular room is ₹ 9100 at ₹ 65 per m^2. The ratio of the length and breadth of the floor is 7 : 5. The perimeter (in m) of the floor of the room is:
A. 36 B. 24
C. 48 D. 28.8

63. The average of ten numbers is 32.5. The average of first four numbers is 25.6 and that of the last three numbers is 38.2. The 5th number is 50% more than the 6th number and 8 less than the 7th number. What is the average of 5th and 7th numbers?
A. 42 B. 41
C. 42.4 D. 41.5

64. ABCD is a cyclic quadrilateral. AB and DC meet at F, when produced. AD and BC meet at E, when produced. If ∠BAD = 68° and ∠AEB = 27°, then what is the measure of ∠BFC?
A. 27° B. 22°
C. 17° D. 15°

65. Medicines of three different flavours—A, B and C (in lakh bottles) manufactured by a pharmaceutical company over a period of five years from 2010 to 2014 is given in the bar graph.

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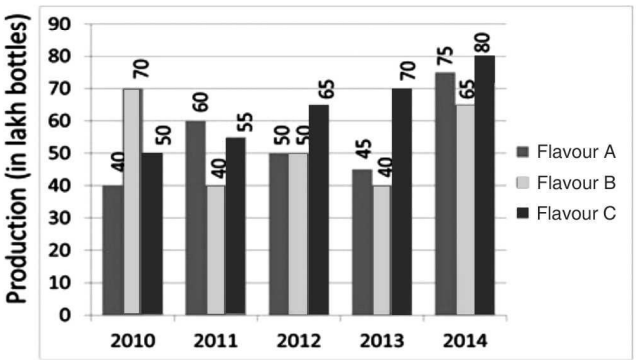

Production of flavour A in 2012 is what percent less than the average production of flavour B in all the years (correct to 2 decimal places)?

A. 3.87 B. 4.66
C. 6.98 D. 5.66

66. If the 5-digit number 688*xy* is divisible by 3, 7 and 11, then what is the value of $(5x + 3y)$?

A. 36 B. 23
C. 43 D. 39

67. If $5 \sin^2 \theta - 4 \cos \theta - 4 = 0$, $0° < \theta < 90°$, then the value of $(\cot \theta + \text{cosec } \theta)$ is:

A. $\frac{\sqrt{6}}{2}$ B. $\frac{\sqrt{6}}{3}$

C. $\frac{3}{2}$ D. $\frac{2}{3}$

68. Suman travels from place X to Y and Rekha travels from Y to X, simultaneously. After meeting on the way, Suman and Rekha reach Y and X in 3 hours 12 minutes and one hour 48 minutes, respectively. If the speed of Rekha is 9 km/h, then the speed (in km/h) of Suman is:

A. $7\frac{1}{2}$ B. 8

C. 6 D. $6\frac{3}{4}$

69. ΔABC is an equilateral triangle. D is a point on side BC such that BD : BC = 1 : 3. If AD = $5\sqrt{7}$ cm, then the side of the triangle is:

A. 20 cm B. 18 cm
C. 15 cm D. 12 cm

70. The income of A is 20% less than the income of B and the income of C is 70% of the sum of incomes of A and B. The income of D is 25% more than the income of C. If the difference between the incomes of B and D is ₹ 23000, then what is the income (in ₹) of A?

A. 28000 B. 26000
C. 32000 D. 25000

Directions (Qs. No. 71-75): *Read the passage carefully and answer these questions.*

Two renowned international Software companies, namely Pollaris and Contigent, started their business in the year 2007 and both the companies were in competition with each other in profit making. Pollaris earned 30 per cent profit in the year 2007 and 2008, and further increased it to 40 per cent in 2009. However, its profit percentage decreased to 20 per cent in the year 2010. On the other hand, Contigent opened with 40 per cent profit in 2007, but slowly decreased to 35 per cent in 2008 and 30 per cent in 2009. Interestingly, both the companies increased their profit percentage in the later year considerably. Pollaris increased its profit percentage to 35 per cent in 2011 and 50 per cent in 2012; simultaneously, Contigent increased its profit percentage to 45 per cent in 2010, 50 per cent in 2011 and reached 60 per cent in the year 2012. As there is a need to understand the income and expenditure for the better performance of both companies in the future, answer the following questions.

71. What is the increase in profit of Contigent Company in percentage from year 2011 to 2012?

A. 10%
B. 20%
C. 15%
D. Cannot be determined

72. What percentage of the total profit making of Pollaris Company in 2011 and 2012 is the total profit making of Contigent Company in 2007 and 2008?

A. 113.3% B. 95.3%
C. 90.3% D. 133.3%

73. If the income of Contigent Company in 2008 was ₹ 200 crores, what was its profit in 2009?

A. ₹ 21.5 Crore
B. ₹ 46.15 Crore
C. ₹ 153 Crore
D. Cannot be determined

74. What is the difference between the company with highest annual average profit percentage and that of the company with lowest annual average profit percentage?

A. 5.17 B. 8.33
C. 9.17 D. 4.33

75. What is the percentage increase in profit of Pollaris Company from year 2010 to 2011?

A. 42.86
B. 75
C. 175
D. Cannot be determined

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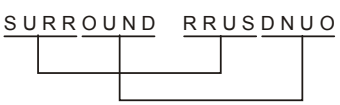
ANSWERS

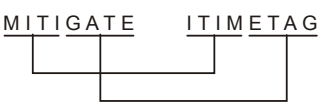
1	2	3	4	5	6	7	8	9	10
D	D	D	C	C	C	B	C	B	D
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
C	A	D	D	B	D	A	D	D	B
21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
C	B	C	D	C	C	D	D	C	A
31	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
B	D	D	A	B	B	A	C	B	B
41	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**
D	D	B	C	D	C	A	B	D	B
51	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**
C	A	C	C	C	D	A	D	A	D
61	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**	**70**
B	C	D	C	D	D	A	D	C	C
71	**72**	**73**	**74**	**75**					
B	A	D	C	B					

EXPLANATORY ANSWERS

1. Given, In a code language



Similarly,



The word is divided into two sections and the letters are written backwards.

Hence, MITIGATE will be written as ITIMETAG.

2. Given, In a code language,

'NOSTALGIA' is coded as '81'

Here, number of letters = 9

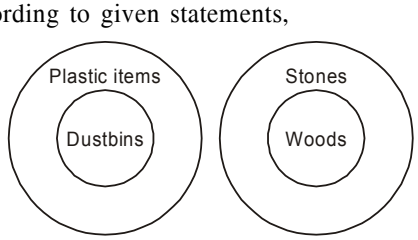
$\therefore \quad 9^2 = 81$

Similarly, number of letters in FRICTION = 8

$\therefore \quad 8^2 = 64$

Hence, 'FRICTION' will be coded as 64.

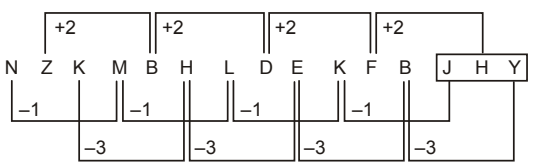
4. According to given statements,



Conclusions: I. No dustbin is word.

II. No plastic item is wood.

6.



Hence, the next term = ? = JHY.

8. $78 \div 48 \times 8 + (26 \times 7) - 39 + (45 + 15) = 210$

Check options:

A. 78 and 45

$\therefore 45 \div 48 \times 8 + (26 \times 7) - 39 + (78 + 15) = 210$

$$\Rightarrow \quad \frac{15}{16} \times 8 + 182 - 39 + 93 = 210$$

$$\Rightarrow \quad \frac{15}{2} + 143 + 93 = 210$$

$$\Rightarrow \quad \frac{15}{2} + 236 = 210$$

Given equation is not correct.

B. 45 and 48

$\therefore 78 \div 45 \times 8 + (26 \times 7) - 39 + (48 + 15) = 210$

$$\Rightarrow \quad \frac{26}{15} \times 8 + 182 - 39 + 63 = 210$$

$$\Rightarrow \quad \frac{208}{15} + 139 + 63 = 210$$

$$\Rightarrow \quad \frac{208}{15} + 202 = 210$$

Given equation is not correct.

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C. 48 and 39

$\therefore$ $78 \div 39 \times 8 + (26 \times 7) - 48 + (45 + 15) = 210$

$\Rightarrow$ $2 \times 8 + 182 - 48 + 60 = 210$

$\Rightarrow$ $16 + 182 - 48 + 60 = 210$

$\Rightarrow$ $158 - 48 = 210$

$\Rightarrow$ $210 = 210$

Given equation is correct.

D. 26 and 15

$\therefore$ $78 \div 48 \times 8 + (15 \times 7) - 39 + (45 + 26) = 210$

$\Rightarrow$ $\frac{26}{16} \times 8 + 105 - 39 + 71 = 210$

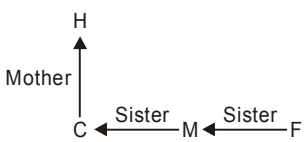
$\Rightarrow$ $13 + 105 - 39 + 71 = 210$

$\Rightarrow$ $189 - 39 = 210$

$\Rightarrow$ $150 = 210$

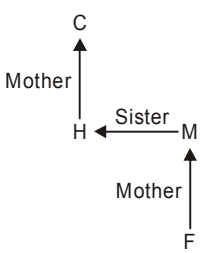
Given equation is not correct.

10. A. H@C#M#F



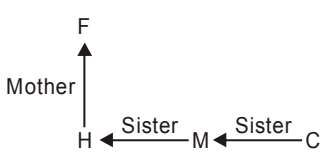
Expression means C is the sister of F.

B. C@H#M@F



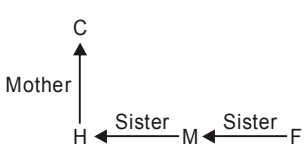
Expression means C is the grandmother of F.

C. F@H#M#C



Expression means F is the mother of C.

D. C@H#M#F



Expression means C is the mother of F.

14. Given, the number of the Set (5, 11, 275)

$\Rightarrow$ $5^2 \times 11 = 25 \times 11 = 275$

A. (6, 18, 180) $\Rightarrow$ $6^2 \times 18 = 36 \times 18 = 648$

B. (9, 15, 270) $\Rightarrow$ $9^2 \times 15 = 81 \times 15 = 1215$

C. (8, 14, 49) $\Rightarrow$ $8^2 \times 14 = 64 \times 14 = 896$

D. (4, 16, 256) $\Rightarrow$ $4^2 \times 16 = 16 \times 16 = 256$

Hence, D is the related to the same way as the given set.

19. K_CTQ_OC__KO_T_KO_TT

A. O, K, T, R, C, T, C

$\therefore$ KOCTQKOCTBKOCTTKOCTT

B. P, K, T, R, C, S, C

$\therefore$ KPCTQKOCTRKOCTSKOCTT

C. O, K, U, R, C, S, C

$\therefore$ KOCTQKOCURKOCTSKOCTT

D. O, K, T, R, C, S, C

$\therefore$ KOCTQKOCTRKOCTSKOCTT

+1 +1 +1

Section KOCT is repeated

Hence, (D) will complete the given series.

20. 10 June 2011 = (2010 years + period from 1.1.2011 to 10.6.2011)

$\because$ Odd day in 2000 years = 0

and 10 years = (2 leap years + 8 ordinary years)

= $(2 \times 2 + 8 \times 1)$ odd day

= 12 odd days

= 1 week + 5 days

= 5 odd days

$\therefore$ Odd days in 2010 years = 0 + 5 = 5

January (31) + February (28) + March (31) + April (30) + May (31) + June (10) = 161 days

$\because$ 161 days = 23 weeks = odd days

$\therefore$ Total number of odd days = 5 + 0 = 5

Hence, the required day is Friday.

51. Given, $x + y + z = 1$

$xy + yz + zx = xyz = -4$

$\because$ $(x + y + z)^2 = x^2 + y^2 + z^2 + 2(xy + yz + zx)$

$\therefore$ $1 = x^2 + y^2 + z^2 + 2 \times -4$

$\Rightarrow$ $x^2 + y^2 + z^2 = 1 + 8 = 9$

$\Rightarrow$ $x^2 + y^2 + z^2 = 9$

We know that, $x^3 + y^2 + z^3 - 3xyz$

$= (x + y + z)(x^2 + y^2 + z^2 - xy - yz - zx)$

$= 1(9 + 4) = 13$

$\Rightarrow$ $x^3 + y^3 + z^3 = 13 + 3xyz$

$= 13 + 3(-4)$

$= 13 - 12$

$= 1$

Hence, $x^3 + y^3 + z^3 = 1$.

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52. $\because\ (a-x)^3$

$= {}^nC_0a^3 + {}^3C_1a^{3-1}(-x) + {}^3C_2a^{3-2}(-x)^2 + {}^3C_3(-x)^3$

$= a^3 - 3a^2x + 3ax^2 - x^3$

$[\because\ {}^3C_0 = 1,\ {}^3C_1 = 3,\ {}^3C_2 = 3 \text{ and } {}^3C_3 = 1]$

$\therefore\ \left(5x^2 - \frac{1}{x}\right)^3$

$= (5x^2)^3 - 3(5x)^2.\frac{1}{x} + 3(5x^2).\left(\frac{1}{x}\right)^2 + -\left(\frac{1}{x}\right)^3$

$= 125x^6 - 15x + 15 - \frac{1}{x^3}$

Hence, the constant term in the expansion = 15.

54. Let Marked price of an article = ₹ x

Then, cost price = ₹ $x \times \frac{100-30}{100}$

= ₹ $\frac{7}{10}x$

and selling price = ₹ $x \times \frac{100-5}{100}$

= ₹ $\frac{19}{20}x$

$\therefore$ Profit = S.P. − C.P.

$\Rightarrow\ 65 = \frac{19}{20}x - \frac{7}{10}x$

$\Rightarrow\ \frac{19x-14x}{20} = 65$

$\Rightarrow\ \frac{5x}{20} = 65$

$\Rightarrow\ \frac{1}{4}x = 65$

$\Rightarrow\ x = 65 \times 4$

$\Rightarrow\ x =$ ₹ 260

Hence, the marked price of the article = ₹ 260.

55. Given, $\tan\theta = \sqrt{5}$

$\sec\theta = \sqrt{1+\tan^2} = \sqrt{1+5} = \sqrt{6}$

$\therefore\ \cos\theta = \frac{1}{\sqrt{6}}$

$\because\ \sin\theta = \sqrt{1-\cos^2\theta}$

$= \sqrt{1-\frac{1}{6}}$

$= \sqrt{\frac{5}{6}}$

$\therefore\ \text{cosec}\,\theta = \sqrt{\frac{6}{5}}$

$\therefore\ \frac{\text{cosec}^2\theta + \sec^2\theta}{\text{cosec}^2\theta - \sec^2\theta} = \frac{\frac{6}{5}+6}{\frac{6}{5}-6}$

$= \frac{\frac{6+30}{5}}{\frac{6-30}{5}}$

$= \frac{36}{-24}$

$= -\frac{6}{4}$

$= -\frac{3}{2}.$

56. Given, Sum = ₹ 6342

Ratio = A : B : C : D = 3 : 4 : 8 : 6

Share of B = ₹ $6342 \times \frac{4}{3+4+8+6}$

$= 6342 \times \frac{4}{21}$

$= 302 \times 4$

= ₹ 1208

and share of D = ₹ $6342 \times \frac{6}{21} = 302 \times 6 =$ ₹ 1812

Hence, the difference between the shares of B and D

= ₹ 1812 − ₹ 1208

= ₹ 604.

58. $6 \div 4 \text{ of } 3 - 4 \div 6 \times (13-10) - 2 \times 15 \div 6 \times 6$

$= 6 \div 4 \text{ of } 3 - 4 \div 6 \times 3 - 2 \times 15 \div 6 \times 6$

$= 6 \div 12 - 4 \div 6 \times 3 - 2 \times 15 \div 6 \times 6$

$= \frac{6}{12} - \frac{4}{6} \times 3 - 2 \times \frac{15}{6} \times 6$

$= \frac{1}{2} - \frac{2}{3} \times 3 - 2 \times 15$

$= \frac{1}{2} - 2 - 30$

$= +\frac{1}{2} - 32$

$= \frac{+1-64}{2}$

$= \frac{-63}{2}$

$= -31\frac{1}{2}.$

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59. Given, P = ₹ 3125, A = ₹ 3515.20

t = 3 years, $r = x\%$

$\because$ Interest being compounded yearly

$$\therefore \quad A = P\left(1+\frac{r}{100}\right)^t$$

$$3515.20 = 3125\left(1+\frac{x}{100}\right)^3$$

$$\Rightarrow \quad \left(1+\frac{x}{100}\right)^3 = \frac{3515.20}{3125}$$

$$\Rightarrow \quad \left(1+\frac{x}{100}\right)^3 = \frac{351520}{312500} = \frac{17576}{15625}$$

$$\Rightarrow \quad \left(1+\frac{x}{100}\right)^3 = \left(\frac{26}{25}\right)^3$$

$$\Rightarrow \quad 1+\frac{x}{100} = \frac{26}{25}$$

$$\Rightarrow \quad \frac{x}{100} = \frac{26}{25}-1 = \frac{1}{25}$$

$$\Rightarrow \quad x = 4\%$$

Now, Simple interest = $\frac{Prt}{100} = \frac{3125\times(x+2)\times 3}{100}$

$$= \frac{3125\times 6\times 3}{100}$$

$$= \frac{125\times 6\times 3}{4}$$

$$= \frac{125\times 3\times 3}{2}$$

$$= \frac{1125}{2}$$

$$= 562.50$$

Hence, required simple interest = ₹ 562.50.

60. $\because$ A's 1 day's work = $\frac{1}{60}$

$\therefore$ B is 25% more efficient than A

$\therefore$ A : B = 4 : 5

Ratio of time (days)

A : B = 5 : 4

$\therefore$ A's 1 day's work = $\frac{1}{60}$

$$\therefore \quad \frac{1}{5x} = \frac{1}{60}$$

$\Rightarrow x = 12$

Hence, B's 1 day's work = $\frac{1}{48}$

Now, (A + B)'s 15 days' work

$$= 15\left(\frac{1}{60}+\frac{1}{48}\right)$$

$$= 15\left(\frac{4+5}{240}\right)$$

$$= \frac{5\times 9}{80}$$

$$= \frac{9}{16}$$

$\therefore$ Remaining work = $1-\frac{9}{16} = \frac{7}{16}$

$\because$ C alone completes the remaining work in 14 days

$\therefore$ C's 1 day's work = $\frac{7/16}{14} = \frac{7}{16\times 14} = \frac{1}{32}$

$\therefore$ (B + C)'s 1 day's work = $\frac{1}{48}+\frac{1}{32} = \frac{2+3}{96} = \frac{5}{96}$

Hence, B and C will completes $\frac{5}{8}$ th part of the original work in $\frac{96}{5}\times\frac{5}{8}$ days = 12 days.

62. Let the length and breadth of the rectangular floor are $7x$ and $5x$ m

then, Area = $l \times b$

$= 7x \times 5x = 35x^2$ m^2

$\therefore$ The cost of tilling the floor = ₹ 9100

₹ $65 \times 35x^2$ = ₹ 9100

$$\Rightarrow \quad x^2 = \frac{9100}{65\times 35} = \frac{260}{65} = 4$$

$\Rightarrow x = 2$

$\therefore$ Length = $7x = 7 \times 2 = 14$ m

and breadth = $5x = 5 \times 2 = 10$ m

Hence, the perimeter of the floor of the room

$= 2(l + b) = 2(14 + 10)$

$= 2 \times 24 = 48$ m.

63. The sum of ten numbers = 325

The sum of first four numbers = $4 \times 25.6 = 102.4$

The sum of last three numbers = $3 \times 38.2 = 114.6$

Let the 6th number = x

then, the 5th number = $\frac{3}{2}x$

and the 7th number = $\frac{3}{2}x+8$

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According to question,

The sum of first four numbers (5th + 6th + 7th) number + the sum of the last three numbers

= The sum of ten numbers

$\Rightarrow 102.4+\frac{3}{2}x+x+\frac{3}{2}x+8+114.6=325$

$\Rightarrow (102.4 + 114.6) + 4x + 8 = 325$

$\Rightarrow 217 + 8 + 4x = 325$

$\Rightarrow 225 + 4x = 325$

$\Rightarrow 4x = 325 - 225$

$\Rightarrow x = \frac{100}{4}=25$

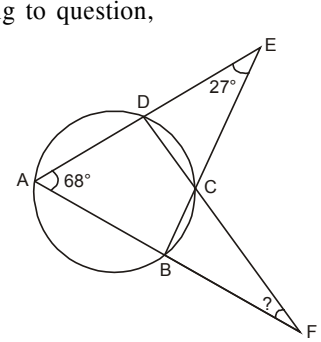
Hence, the average of 5th and 7th numbers

$= \frac{\frac{3}{2}x+\frac{3}{2}x+8}{2}=\frac{3x+8}{2}$

$= \frac{3\times25+8}{2}=\frac{75+8}{2}=\frac{83}{2}$

= 41.50.

64. According to question,



In a cyclic quadrilateral ABCD

Given,

$\Rightarrow \angle BAD = 68°, \angle AEB = 27° \Rightarrow \angle DEC = 27°$

$\Rightarrow \angle A = 68°$

We have to find $\angle BFC = ?$

$\because \angle EDC = \angle ABC$ and $\angle DCE = \angle A$

$\Rightarrow \angle EDC = \angle ABC$ and $\angle DCE = 68°$

$\because \angle FBC = \angle ADC$ and $\angle BCF = \angle A$

$\Rightarrow \angle FBC = 180° - \angle ABC$ and $\angle BCF = 68°$

$\Rightarrow \angle FBC = 180° - (180° - [68° + 27°])$

$= 95°$ and $\angle BCF = 68°$

Now, in ΔBFC,

$\angle BFC = 180° - (\angle FBC + \angle BCF)$

$= 180° - (95° + 68°) = 180° - 163° = 17°$

Hence, $\angle BFC = 17°$.

65. From given bar graph:

Production of flavour A in 2012 = 50

and the average production of flavour B in all the years.

$= \frac{70+40+50+40+65}{5}=\frac{265}{5}=53$

Hence, required $\% = \frac{53-50}{53}\times100\% = \frac{300}{53}=5.66\%$.

66. Given, the 5-digit numbers = 688*xy*

$\because$ LCM of 3, 7 and 11 = 231

According to question,

688*xy* is divisible by 231

$\therefore 688xy = 231 \times 298$

$\Rightarrow 68838 = 231 \times 298$

$\therefore x = 3$ and $y = 8$

Hence, $5x + 3y = 5 \times 3 + 3 \times 8$

$= 15 + 24 = 39.$

67. Given, $5 \sin^2 \theta - 4 \cos \theta - 4 = 0$,

$0° < \theta < 90°$

$\Rightarrow 5(1 - \cos^2 \theta) - 4 \cos \theta - 4 = 0$

$\Rightarrow 5 - 5 \cos^2 \theta - 4 \cos \theta - 4 = 0$

$\Rightarrow -5 \cos^2 \theta - 4 \cos \theta + 1 = 0$

$\Rightarrow 5 \cos^2 \theta + 4 \cos \theta - 1 = 0$

$\Rightarrow 5 \cos^2 \theta + 5 \cos \theta - \cos \theta - 1 = 0$

$\Rightarrow 5 \cos \theta(\cos \theta + 1) - 1(\cos \theta + 1) = 0$

$\Rightarrow (5 \cos \theta - 1)(\cos \theta + 1) = 0$

$\Rightarrow \cos \theta = \frac{1}{5}, \cos \theta = -1$

$\because \cos \theta = \frac{1}{5}$

$\therefore \sin \theta = \sqrt{1-\cos^2 \theta}$

$= \sqrt{1-\frac{1}{25}}=\sqrt{\frac{24}{25}}=\frac{2\sqrt{6}}{5}$

$\because \cot \theta + \operatorname{cosec} \theta = \frac{1}{2\sqrt{6}}+\frac{5}{2\sqrt{6}}$

$= \frac{1+5}{2\sqrt{6}}=\frac{6}{2\sqrt{6}}=\frac{\sqrt{6}}{2}.$

70. Let the income of B is ₹ x

then, the income of A $= x\times\frac{100-20}{100} = x\times\frac{80}{100}=\frac{4}{5}x$

and the income of C

$= \left(\frac{4}{5}x+x\right)\times\frac{70}{100} = \frac{7}{10}\left(\frac{9}{5}x\right)=\frac{63}{50}x$

The income of D $= \frac{63}{50}x\times\frac{125}{100} = \frac{63}{50}x\times\frac{5}{4}=\frac{63}{40}x$

Given, The difference between the incomes of B and D = ₹ 23000

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$\Rightarrow \quad \frac{63}{40}x - x = 23000 \Rightarrow \frac{23x}{40} = 23000$

$\Rightarrow \quad x = 1000 \times 40 = 40000$

Hence, the income of A $= \frac{4}{5}x = \frac{4}{5} \times 40000$

$= 4 \times 8000 = ₹\ 32000.$

For Q.No. 71 – 75.

Year	Pollaris	Contigent
2007	30%	40%
2008	30%	35%
2009	40%	30%
2010	20%	45%
2011	35%	50%
2012	50%	60%

71. Required increase in profit percentage of contigent (2011 – 2012)

$= \frac{60-50}{50} \times 100$

$= \frac{10}{50} \times 100$

$= 20\%.$

72. The total profit of pollaris in 2011 and 2012

$= 35 + 50 = 85$

and the total profit of contigent in 2007 and 2008

$= 40 + 35 = 75$

$\therefore \quad 75 \times \frac{x}{100} = 85$

$\Rightarrow \quad x = \frac{8500}{75}$

$= \frac{1700}{15}$

$= 113.33\%$

Hence, required% = 113.33%.

74. Annual average profit percentage of pollaris company

$= \frac{30+30+40+20+35+50}{6}$

$= \frac{205}{6}$

$= 34.16$

and annual average profit percentage of contigent company

$= \frac{40+35+30+45+50+60}{6}$

$= \frac{260}{6}$

$= 43.33$

Hence, the required difference

$= 43.33 - 34.16$

$= 9.17.$

75. The required percentage increase in profit of pollaris company (2010 to 2011)

$= \frac{35-20}{20} \times 100\%$

$= \frac{15}{20} \times 100\% = 75\%.$

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SAMPLE PAPER-2 (SOLVED)

CUET-UG

(Common University Entrance Test for UG Programmes)

GENERAL TEST (SECTION-III)*

GENERAL MENTAL ABILITY/QUANTITATIVE REASONING

1. Select the option that will fill in the blank and complete the given series.

2, 5, 10, 17, 26, 37, ..., 65, 82, 101

A. 54 B. 48
C. 50 D. 51

2. Arrange the following words in a logical and meaningful order.

1. Rajasthan 2. India
3. Jaipur 4. North India
5. Asia

A. 1, 3, 2, 4, 5
B. 1, 3, 4, 2, 5
C. 3, 1, 2, 4, 5
D. 3, 1, 4, 2, 5

3. Three of the following four words are alike in a certain way and one is different. Pick the odd one out.

A. Pedology B. Seismology
C. Terminology D. Cardiology

4. Three of the following four number-pairs are alike in a certain way and one is different. Pick the odd number-pair out.

A. 196 : 14 B. 123 : 11
C. 225 : 15 D. 144 : 12

5. If 'J' is coded as '20' and 'BAT' is coded as '46' then how will 'Cricket' be coded?

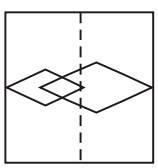
A. 138 B. 158
C. 142 D. 140

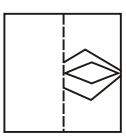
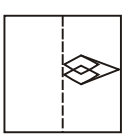
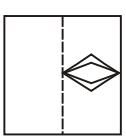
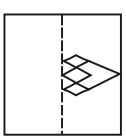
6. Select the option that is related to the third number in the same way as the second number is related to the first number.

19 : 400 :: 24 : .....

A. 652 B. 566
C. 676 D. 625

7. Given here is a square transparent sheet with a pattern on it. How would the pattern appear when the transparent sheet is folded on the dotted line?



A. 
B. 
C. 
D. 

8. A cube coloured pink on all faces is cut into 27 small cubes of equal sizes. How many cubes are painted on one face only?

A. 4 B. 3
C. 8 D. 6

9. Select the combination of letters that when sequentially placed in the gaps of the given letter series will complete the series.

_c_bd_cbcda_a_db_a

A. bdbcba B. adabcd
C. cdcbad D. acbcad

10. Select the term that will come next in the following series.

11, 13, 17, 23, 31, 41, 53, 67, 83, ?

A. 101 B. 97
C. 110 D. 100

11. In a code language, FRIEND is written as GQJDOC. How will PEACE be written in that language?

A. QDBDF
B. ODBBF
C. QFBBF
D. QDBBF

*60 Questions to be attempted out of 75

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12. Select the correct mirror image of the following word when the mirror is placed to the right of the word.

HINT

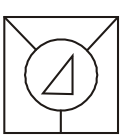
A. TIИH B. HINT
C. TNIH D. TИIH

13. Select the word-pair in which the two words are related in the same way as the two words in the following word-pair.

School : Student :: ..... : .....
A. Hospital : Patient
B. Hotel : Chef
C. Court : Judge
D. College : Teacher

14. ACCIDENT is related to TNEDICCA in the same way as PASSENGER is related to ..... :
A. REGNSESAP B. REGNESSAP
C. REGMESSAP D. RGENESSAP

15. Select the figure in which the given figure is embedded.

A. B. 

C. D.

16. Introducing Kavi, Veena said, "She is the sister of the son of the wife of my husband". How is Veena related to Kavi?
A. Daughter B. Sister
C. Mother D. Aunt

17. Which two signs should be interchanged to make the following equation correct?

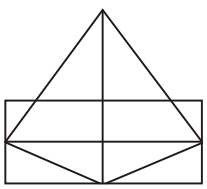
20 ÷ 20 + 20 − 25 × 25 = 419
A. ÷ and × B. + and −
C. + and ÷ D. × and −

18. Select the letter-cluster that is related to the third letter-cluster in the same way that the second letter-cluster is related to the first letter-cluster.

AFKP : BGLQ :: GLQV : ?
A. HMRW B. HNRW
C. HKRW D. HMPW

19. Three of the following four letters are alike in a certain way and one is different. Pick the odd one out.
A. E B. V
C. I D. U

20. How many triangles are there in the following figure?



A. 15 B. 12
C. 10 D. 9

21. Two statements are given, followed by three conclusions numbered I, II and III. Assuming the statements to be true, even if they seem to be at variance with commonly known facts, decide which of the conclusions logically follow(s) from the statements.

Statements :
No grass is a flower.
All flowers are trees.

Conclusions:
I. Some trees are flowers.
II. Some trees are grasses.
III. No tree is a grass.
A. Only conclusion III follows
B. Either conclusions II or III, and I follow
C. Either conclusion II or III follows
D. Only conclusion I follows

Directions (Qs. No. 22-25): *Read the following information and choose the most appropriate option:*

P and Q are good in driving Motor cycle and Jeep. R and P are good in driving Jeep and Lorry. R, S and T are good in driving Motor Cycle and Lorry. T and R are good in driving Bus and Tempo. S and Q are good in driving Bus and Jeep.

22. Who is good in driving Motor cycle, Lorry and Tempo?
A. P B. Q
C. T D. S

23. Who is good in driving Motor Cycle, Jeep and Lorry but not bus?
A. R B. S
C. P D. T

24. Who is good in driving Tempo, Motor Cycle, Lorry but not Jeep?
A. S B. T
C. R D. Q

25. Who is good in driving all the vehicles?
A. R B. P
C. S D. T

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GENERAL KNOWLEDGE

26. The Ayushman Bharat Scheme introduced by the Government of India provides medical coverage of upto ₹ ..... per family per year.
A. 7 lakhs B. 5 lakhs
C. 2 lakhs D. 1 lakh

27. Who appoints the Sate Chief Information Commissioner?
A. Chief Minister B. President
C. Prime Minister D. Governor

28. ..... was named the cleanest city in the 'Swachh Survekshan Survey 2019'.
A. Mysuru B. Surat
C. Indore D. Ujjain

29. What was the historical name of the city of Guwahati?
A. Purushapura B. Bhagyanagara
C. Machilipattnam D. Pragjyotishpur

30. Which of the following is NOT a part of the 'Char Dham Yatra' in North India?
A. Badrinath B. Gangotri
C. Vaishno Devi D. Kedarnath

31. People above the age of ..... years are NOT eligible for the Pradhan Mantri Shram Yogi Mandhan Yojana.
A. 60 B. 40
C. 45 D. 50

32. Name the oldest operating port in India built by the British East India Company.
A. Kolkata Port B. Chennai Port
C. Mumbai Port D. Vishakapatnam Port

33. The Khadi and Village Industries Commission Act was passed in the year .....
A. 1956 B. 1948
C. 1964 D. 1965

34. Mutual Legal Assistance Treaty, approved by the Union Cabinet, is a treaty between India and the:
A. United States of America
B. United Kingdom
C. Portugal
D. Russian Federation

35. As per the state of forest report 2021 data, total area under forest cover and tree cover in India is:
A. 80.9537 million hectares
B. 76.6238 million hectares
C. 70.8182 million hectares
D. 50.1698 million hectares

36. Neeraj Chopra is associated with which game?
A. Cricket B. Javelin Throw
C. Football D. Tennis

37. Which country won the ICC T20 Men's World Cup in 2021?
A. Australia B. England
C. India D. Pakistan

38. During the Sao Joao festivities, Goans present ..... to each other.
A. fruits B. flowers
C. beer D. fish

39. The movement of the local farmers of Bardoli in Gujarat against the British in 1928 was led by ..... .
A. Vallabhbhai Patel
B. Lal Bahadur Shashtri
C. Lokmanya Tilak
D. Jawaharlal Nehru

40. Who was the first Indian to win the Miss Universe title?
A. Madhu Sapre B. Persis Khambatta
C. Reita Faria D. Sushmita Sen

41. Which day will be observed in India as 'Veer Baal Diwas'?
A. November 14 B. January 9
C. January 14 D. December 26

42. The Micro, Small and Medium Enterprises Development Act was passed in the year ..... .
A. 2006 B. 2004
C. 2008 D. 2002

43. An adult human body has ..... bones.
A. 312 B. 206
C. 208 D. 300

44. ..... is the hottest planet in the solar system.
A. Mercury B. Mars
C. Venus D. Earth

45. The 'Instrument of Surrender' which ended the Portuguese rule in India was signed on ..... .
A. 19th December 1961
B. 15th August 1947
C. 29th December 1951
D. 26th January 1948

Directions (Qs. No. 46-50): *Read the passage carefully and answer these questions:*

One thing struck us as a major difference between the new National Education Policy (NEP) 2020 and its predecessor. The earlier national policies on education (NPE) from 1986 and 1992 presented themselves as attempts to consolidate and build on earlier efforts, particularly the NPE, 1968. The

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new NEP 2020 policy, on the other hand, is very keen to establish that it is different from everything in the past, including in its name. Nowhere does this attitude come across as starkly as it does in the section on higher education.

It comes across fairly clearly on how the higher education ecosystem will be by 2040. By this time — if the policy has its way — the Indian higher education ecosystem will be populated with higher education institutions (HEI). These will comprise Universities and Colleges and the public and private sectors, all of which will be 'multi-disciplinary', with each populated by more than 3,000 students, with at least one "in or near every district". Universities will conduct research and post-graduate and under-graduate teaching, some research-intensive and others teaching-intensive. Colleges will largely teach at the under-graduate level, with a number of them having their medium of instruction in either bilingual or local/Indian languages. The colleges can manifest in clusters around universities as constituent colleges or may be standalone autonomous ones. Ideally, all HEIs will eventually become "independent self-governing institutions" with considerable "faculty and institutional autonomy". They will have complied with a series of regulatory exercises that are light-but-tight and will be operated by a large number of private accreditors, overseen by a new set of regulatory institutions at the national level.

46. Which of the following statements are not true in relation to the changes envisioned by the NEP 2020?
A. The NEP 2020 aims at making India a global knowledge superpower.
B. The renaming of the Ministry of Human Resource Development to the Ministry of Education.
C. The development of National Course Curriculum to provide new curriculum by 2021.
D. The New Education Policy aims to facilitate an inclusive, participatory and holistic approach

47. The NEP 2020 aims to provide a holistic change to the current education system in India. Which of the following is not related to the aim of NEP 2020?
A. Universalization of education from preschool to secondary level with 100% Gross Enrolment Ratio.
B. To bring 20 million out of school children back into the mainstream through an open schooling system.
C. Vocational Education to start from Class 6 with Internships.
D. To achieve 80% Gross Enrolment Ratio at the under graduate level.

48. Which of the following is proposed as a change in the structure of institutions responsible for affiliation and accreditation under the NEP 2020?
A. Higher Education Commission of India (HECI) will be set up as a single umbrella body for the entire higher education.
B. University Grant Commission to be renamed as AICTE.
C. National Affiliation and Accreditation Council to be renamed as National Standard Council of India.
D. National Council for Education Research and Teaching to be renamed as BCERT.

49. Which of the following is not a vertical under the Higher Education Commission of India (HECI)?
A. National Higher Education Regulatory Council (NHERC)
B. Higher Education Grants Council (HEGC)
C. National Educational Council (NEC)
D. National Accreditation Council (NAC)

50. What is the proposed percentage of expenditure for education out of GDP under the NEP 2020?
A. 11 per cent B. 6 per cent
C. 4.6 per cent D. 9 per cent

NUMERICAL ABILITY

51. PA and PB are tangents to a circle with centre O, from a point P outside the circle, and A and B are points on the circle. If $\angle APB = 40°$, then $\angle OAB$ is equal to:
A. 50° B. 20°
C. 25° D. 40°

52. If $\tan x = \cot(45° + 2x)$, then what is value of x?
A. $\frac{45°}{2}$ B. 20°
C. 15° D. 45°

53. If the radius of the circumcircle of an equilateral triangle is 8 cm, then the measure of radius of its incircle is:
A. 8 cm B. 12 cm
C. 16 cm D. 4 cm

54. 3 men, 4 women and 6 boys together can complete a work in 6 days. A woman does triple the work a man does and a boy does half the work a man does. How many women alone will be able to complete this work in 4 days?
A. 9 B. 6
C. 8 D. 7

55. Table shows the percentage distribution of the expenditure incurred on different items for publishing a book.

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Item of expenditure	Percentage of expenditure
Paper	25
Printing	20
Binding	20
Royalty	15
Promotion	10
Transportation	10

Expenditure on Royalty is less than that on printing by:

A. 20% B. 25%
C. 15% D. 10%

56. If $x+\frac{1}{x}=5$, then $x^3+\frac{1}{x^3}$ is equal to:

A. 110 B. 130
C. 125 D. 145

57. What is the difference between a single discount of 30% and a single discount equivalent to two successive discounts of 25% and 5%, being given on shopping of ₹ 2,000?

A. ₹ 25 B. ₹ 15
C. ₹ 20 D. No difference

58. $9\frac{3}{4}\div\left[2\frac{1}{6}\div\left\{4\frac{1}{3}-\left(2\frac{1}{2}+\frac{3}{4}\right)\right\}\right]$ is equal to:

A. $\frac{15}{4}$ B. 3

C. $\frac{39}{8}$ D. 4

59. Table shows the percentage of marks obtained by seven students in six different subjects in an examination. The numbers in the brackets are the maximum marks in each subject.

Students	Subject (Max. Marks)					
	Maths (150)	Chemistry (130)	Physics (120)	Geography (100)	History (60)	Computer Sci. (40)
A	90	50	90	60	70	80
B	100	80	80	40	80	70
C	90	60	70	70	90	70
D	80	65	80	80	60	60
E	80	65	85	95	50	90
F	70	75	65	85	40	60
G	65	35	50	77	80	80

What are the average marks obtained by all the seven students in Physics? (Correct to two decimal places)

A. 91.16 B. 93.14
C. 77.26 D. 89.14

60. If $(x-5)^3+(x-6)^3+(x-7)^3=3(x-5)^3(x-6)(x-7)$, then what is the value of x?

A. 18 B. 6
C. 5 D. 7

61. If $a^3-b^3=208$ and $a-b=4$, then $(a+b)^2-ab$ is equal to:

A. 32 B. 38
C. 52 D. 42

62. The average of 27 numbers is zero. Out of them, how many may be greater than zero, at the most?

A. 0 B. 15
C. 26 D. 20

63. A starts walking at 4 kmph and after 4 hours, B starts cycling from the same point as that of A, in the same direction at 10 kmph. After how much distance from the starting point will B catch up with A (correct to two decimal places)?

A. 24.67 km B. 26.67 km
C. 25.67 km D. 23.67 km

64. In ΔABC, $\angle A = 50°$. Its sides AB and AC are produced to the point D and E. If the bisectors of the $\angle CBD$ and $\angle BCE$ meet at the point O, then $\angle BOC$ will be equal to:

A. 65° B. 75°
C. 40° D. 55°

65. If the selling price of 40 articles is equal to the cost price of 50 articles, then the percentage loss or gain is:

A. 25% gain B. 25% loss
C. 20% gain D. 20% loss

66. The value of $\left[\frac{\sin^2 24°+\sin^2 66°}{\cos^2 24°+\cos^2 66°}+\sin^2 61°+\cos 61°\sin 29°\right]$ is:

A. 3 B. 1
C. 2 D. 0

67. If 85% of a number is added to 75, then the result is the number itself. The number is:

A. 500 B. 200
C. 300 D. 100

68. If a sum amounts to ₹ 2,190 is four years and ₹ 2,409 in five years at compound interest, when the interest is compounded yearly, then the annual rate of interest is:

A. 8% B. 10%
C. 9% D. 11%

69. A earns ₹ 180 per hour and works for 7 hours per day. B earns ₹ 160 per hour and works for 5 hours per day. What is the ratio of per day wages of A and B?

A. 40 : 61 B. 33 : 20
C. 20 : 30 D. 63 : 40

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70. Table shows the sales of books (in thousands) from six branches of a publishing company during 2000 and 2001.

Years \ Branches	81	82	83	84	85	86
2000	80	75	95	85	75	70
2001	105	65	110	95	95	80

What is the total sales of books from branches B1, B3 and B6 together for both the years (in thousands)?

A. 650 B. 240
C. 310 D. 540

Directions (Qs. No. 71-75): *Read the passage carefully and answer these questions.*

A newly formed state government wants to bring more development in the state. Therefore, the government proposed to launch various welfare programmes. Before bringing up any welfare programme, the state government intended to understand the population percentage of the state by age groups, so that the government could plan the welfare programmes accordingly. The state government found that the state's 30 per cent of the population were children between the age group of 0-15. Next to child population, 17.75 per cent of the population were adolescents between the age group of 16 and 25. The early adult population, *i.e.*, the age groups 26 to 35 were 17.25 per cent, 36 to 45 were 14.50 per cent, respectively. The population who are between the age group of 46 to 55 constitute 14.25 per cent and the elderly population of the state, *i.e.*, 56 to 65 (5.12%) and 66 above (1.13%) was comparatively less than the other age groups. To get a better clarity, the state government concerned is seeking the answers to following questions:

71. Out of every 5,600 persons, what is the number of persons below the age of 26 years?

A. 2515 B. 1746
C. 1660 D. 2674

72. There are 400 million people below 36 years. How many million (approx.) people are in the age group 56-65?

A. 32.72 million B. 25.75 million
C. 31.50 million D. 59.30 million

73. If there are 20 million people in the age group 56 to 65, what is the difference between the number of people in the age groups 16-25 and 46-55?

A. 15.6 million B. 12.18 million
C. 28.4 million D. 34.7 million

74. If the difference between the number of people in the age groups 46-55 and 26-35 is 15.75 million, then total population of the state is approximately?

A. 360.23 million B. 390 million
C. 400 million D. 525 million

75. Which age group accounts for the maximum population in the state?

A. 16 to 25 B. 26 to 35
C. 36 to 45 D. None of the above

ANSWERS

1	2	3	4	5	6	7	8	9	10
C	D	C	B	A	D	D	D	B	A
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
D	D	A	B	D	C	A	A	B	A
21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
B	C	C	B	A	B	D	C	D	C
31	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
B	A	A	C	A	B	A	A	A	D
41	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**
D	A	B	C	A	C	D	A	C	B
51	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**
B	C	D	A	B	A	A	C	D	B
61	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**	**70**
C	C	B	A	A	C	A	B	D	D
71	**72**	**73**	**74**	**75**					
D	C	B	D	A					

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EXPLANATORY ANSWERS

1. 2 5 10 17 26 37 [50] 65 82 101

+3 +5 +7 +9 +11 +13 +15 +17 +19

+2 +2 +2 +2 +2 +2 +2 +2 +2

2. (3) Jaipur (1) Rajasthan (4) North India (2) India (5) Asia

4. Except (2), In all other groups of number second number is the square root of the first number.

5. As J code is 20 *i.e.* 2 × 10

BAT code is 46 *i.e.* 2 × (2 + 1 + 20)

Similarly,

CRICKET code is 2 × (3 + 18 + 9 + 3 + 11 + 5 + 20)

= 2 × (69)

= 138.

6. 19 : 400 :: 24 : [625]

$= (19 + 1)^2$ $= (24 + 1)^2$

8. $\because n = \dfrac{\sqrt[3]{27}}{\sqrt[1]{1}} = \dfrac{3}{1} = 3$

No. of Cubes, painted on one face = $6(n - 2)^2$

$= 6(3 - 2)^2$

$= 6 \times 1$

$= 6.$

9. a c d b / d a c b / c d a b / a c d b / d a

1 2 3 4 3 1 2 4 3 1 2 4 3 1 2 4 3 1

The pattern of the series is 3124 of the previous group.

10. 11 13 17 23 31 41 53 67 83 [101]

+2 +4 +6 +8 +10 +12 +14 +16 +18

+2 +2 +2 +2 +2 +2 +2 +2

11. As, F R I E N D

+1 −1 +1 −1 +1 −1

G Q J D O C

Similarly,

P E A C E

+1 −1 +1 −1 +1

Q D B B F

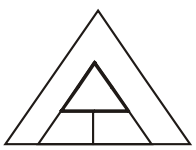
13. As student is related to school similarly patient is related to hospital.

14. As, ACCIDENT $\xrightarrow[\text{Order}]{\text{Reverse}}$ TNEDICCA

Similarly,

PASSENGER $\xrightarrow[\text{Order}]{\text{Reverse}}$ REGNESSAP

15.



16. Veena ⇌ Husband

Wife

Mother

Kavi ← Son

Sister

Veena is the mother of Kavi.

17. (1) Check ÷ and X

20 × 20 + 20 − 25 ÷ 25

According to BODMAS Rule

= 20 × 20 + 20 − 1

= 400 + 20 − 1

= 420 − 1

= 419

= RHS

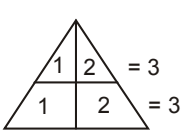
Hence option (A) is correct.

18. A F K P : B G L Q :: G L Q V : [H M R W]

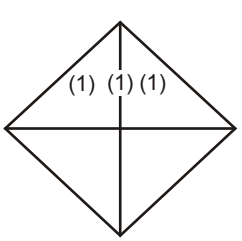
+1 +1 +1 +1

19. 'V' is a consonant of english alphabet.

20.

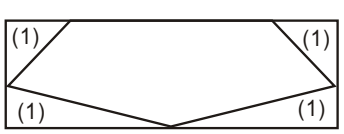


Total = 3 + 3 = 6



Total triangle = 8 but three already counted

= 8 − 3 = 5



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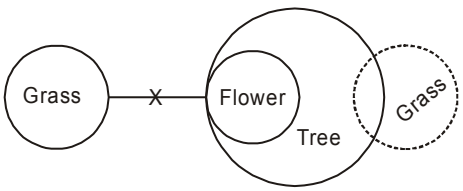
Total triangle = 4

∴ Total triangles are in the figure

= 6 + 5 + 4

= 15.

21.



(I) Some trees are flowers (True)

(II) Some trees are grasses (May be true)

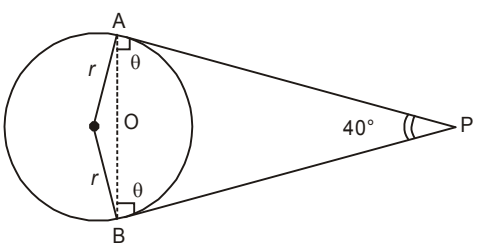
(III) No tree is a grass (May be true)

∴ Either Conclusions II or III, and I follow.

For 22-25.

	Motor Cycle	Jeep	Lorry	Bus	Tempo
P	✔	✔	✔	✘	✘
Q	✔	✔	✘	✔	✘
R	✔	✔	✔	✔	✔
S	✔	✔	✔	✔	✘
T	✔	✘	✔	✔	✔

51.



$\angle AOB = 180° - 40° = 140°$

$\angle OAB = \angle OBA$ [$\because$ OA = OB = Radius]

In ΔOAB,

$\theta + \theta + 140 = 180°$

$2\theta = 40°$

$\theta = 20°$

$\therefore \quad \angle OAB = 20°$

52. $\tan x = \cot(45° + 2x)$

We can written this

$\cot(90 - x) = \cot(45 + 2x)$

$90 - x = 45 + 2x$

$3x = 45$

$x = 15°$.

53. We know that circumcircle radius of equilateral

Triangle (R) $= \frac{a}{\sqrt{3}}$

In radius (r) $= \frac{a}{2\sqrt{3}}$

$\therefore \quad R : r = 2 : 1$

2 unit value = 8

1 unit value = 4

$\therefore$ In radius = 4 cm.

54. W = 3 m

M : W = 1 : 3 = 2 : 6

$B = \frac{1}{2}$ m

M : B = 2 : 1

$\therefore$ M : B : W = 2 : 1 : 6

Let x women will be able to complete the work in 4 days.

Let the efficiency of Men, Boys and Women are $2t$, t and $6t$ respectively.

$W_1 = W_2$

$M_1 \times D_1 = M_2 \times D_2$

$(3 \times 2t + 4 \times 6t + 6 \times t) \times 6 = 6t \times x \times 4$

$36t \times 6 = 6t \times x \times 4$

$x = \frac{6 \times 6}{4}$

$x = 9$ days.

55. Required percentage

$= \frac{20 - 15}{20} \times 100$

$= \frac{5}{20} \times 100$

$= 25\%$.

56. Given, $x + \frac{1}{x} = 5$

then, $x^3 + \frac{1}{x^3} = \left(x + \frac{1}{x}\right)^3 - 3\left(x + \frac{1}{x}\right)$

$= (5)^3 - 3(5)$

$= 125 - 15$

$= 110$.

57. Amount of single discount 30%

= 2000 × 30%

= ₹ 600

Equivalent discount of 25% and 5%

$= 25 + 5 - \frac{25 \times 5}{100}$

= 30 − 1.25

= 28.75%

Amount of discount 28.75%

= 2000 × 28.75%

= ₹ 575

Required difference = 600 − 575

= ₹ 25.

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58. $9\frac{3}{4} \div \left[2\frac{1}{6} \div \left\{4\frac{1}{3} - \left(2\frac{1}{\underline{2} + \frac{3}{4}}\right)\right\}\right]$

According to BODMAS rule

$$= \frac{39}{4} \div \left[\frac{13}{6} \div \left\{\frac{13}{3} - \left(\frac{5}{\underline{2} + \frac{3}{4}}\right)\right\}\right]$$

$$= \frac{39}{4} \div \left[\frac{13}{6} \div \left\{\frac{13}{\underline{3} - \frac{13}{4}}\right\}\right]$$

$$= \frac{39}{4} \div \left[\frac{13}{6} \div \frac{13}{12}\right]$$

$$= \frac{39}{4} \div \left[\frac{13}{6} \times \frac{12}{13}\right]$$

$$= \frac{39}{4} \div 2$$

$$= \frac{39}{4} \times \frac{1}{2} = \frac{39}{8}.$$

60. $(x-5)^3 + (x-6)^3 + (x-7)^3 = 3(x-5)(x-6)(x-7)$

We know that,

if $x^3 + y^3 + z^3 = 3xyz$

then $x + y + z = 0$

$\therefore (x-5) + (x-6) + (x-7) = 0$

$3x - 18 = 0$

$x = 6.$

61. $\because \quad a^3 - b^3 = (a-b)(a^2 + b^2 - ab)$

$a^3 - b^3 = (a-b)((a+b)^2 - ab)$

$208 = 4((a+b)^2 - ab)$

$(a+b)^2 - ab = \frac{208}{4} = 52.$

63. In 4 hour A covered the distance

$= 4 \times 4 = 16$ km

Now, Relative speed of A and B

$= 10 - 4$

$= 6$ km/h

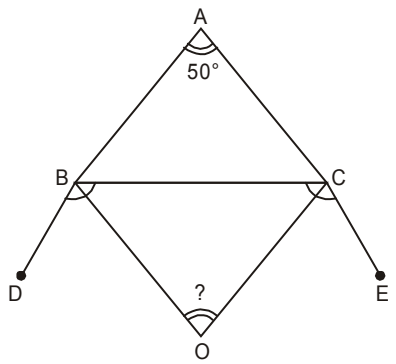
Required time to catch A $= \frac{16}{6}$h

Distance covered by B in $\frac{16}{6}$h

$$= 10 \times \frac{16}{6} = \frac{160}{6}$$

$= 26.67$ km.

64.



$\because \quad \angle BOC = 90 - \frac{\angle A}{2}$

$$= 90 - \frac{50}{2}$$

$= 90 - 25$

$= 65°.$

65. Selling price × 40 = Cost price of 50 article

$\therefore \quad \frac{\text{Selling price}}{\text{Cost price}} = \frac{50}{40} = \frac{5}{4}$

$$\%P = \frac{SP - CP}{CP} \times 100$$

$$= \left(\frac{SP}{CP} - 1\right) \times 100$$

$$= \left(\frac{5}{4} - 1\right) \times 100$$

$$= \frac{1}{4} \times 100 = 25\% \text{ gain}.$$

66. $\left[\frac{\sin^2 24° + \sin^2 66°}{\cos^2 24° + \cos^2 66°} + \sin^2 61° + \cos 61° \sin 29°\right]$

$$= \left[\frac{\sin^2 24° + \sin^2(90° - 24°)}{\cos^2(90° - 66°) + \cos^2 66°} + \sin^2 61° + \cos 61° \sin(90° - 61°)\right]$$

$$= \left[\frac{\sin^2 24° + \cos^2 24°}{\sin^2 66° + \cos^2 66°} + \sin^2 61° + \cos^2 61°\right]$$

$$= \left[\frac{1}{1} + 1\right] \qquad [\because \sin^2\theta + \cos^2\theta = 1]$$

$= 1 + 1 = 2.$

67. Let the number = x

According to question,

$85\%x + 75 = x$

$\frac{85x}{100} + 75 = x$

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$$x - \frac{85x}{100} = 75$$

$$\frac{15x}{100} = 75$$

$$x = \frac{75 \times 100}{15} = 500.$$

68. $\because$ $A = P\left(1+\frac{r}{100}\right)^t$

$$2190 = P\left(1+\frac{r}{100}\right)^4 \quad ...(1)$$

$$2409 = P\left(1+\frac{r}{100}\right)^5 \quad ...(2)$$

Eq. 2 ÷ eq. (1), we get

$$\therefore \quad 1+\frac{r}{100} = \frac{2409}{2190}$$

$$\therefore \quad \frac{r}{100} = \frac{2409}{2190} - 1$$

$$\frac{r}{100} = \frac{219}{2190}$$

$$r = \frac{21900}{2190} = 10\%.$$

69. 'A' per day wage = ₹ 180 × 7 = ₹ 1260

B per day wage = 160 × 5 = 800

Required ratio = 1260 : 800 = 63 : 40

70. Total sales of Books from branched B_1, B_2, and B_6 on 2000 (in thousands)

= 80 + 95 + 70

= 245

Total sales of Books from branched B_1, B_2, and B_6 on 2001 (in thousands)

= 105 + 110 + 80 = 295

Required total sales = 245 + 295 = 540.

71 – 75.

From given information

Age Group (Years)	Population
0 – 15	30%
16 – 25	17.75%
26 – 35	17.25%
36 – 45	14.50%
46 – 55	14.25%
56 – 65	5.12%
66 above	1.13%

71. The number of persons below the age of 26 year

$$= 5600 \times \frac{30+17.75}{100}$$

$$= 5600 \times \frac{47.75}{100}$$

$$= 56 \times 47.75$$

$$= 2674.$$

72. Let the total population = x

Then, $\frac{x \times (30+17.75+17.25)}{100} = 400$

$$\Rightarrow \quad x \times \frac{65}{100} = 400 \text{ million}$$

$$\Rightarrow \quad x \times \frac{13}{20} = 400$$

$$\Rightarrow \quad x = 400 \times \frac{20}{13} \text{ million}$$

Hence, the number of people are in the age group 56 – 65

$$= 400 \times \frac{20}{13} \times \frac{5.12}{100}$$

$$= \frac{4 \times 20 \times 5.12}{13}$$

$$= \frac{80 \times 5.12}{13}$$

$$= \frac{409.6}{13}$$

$$= 31.50 \text{ million}.$$

73. The population = x

$\because$ The number of people in the age group 56 – 65

= 20 million

$$\therefore \quad x \times \frac{5.12}{100} = 20$$

$$\Rightarrow \quad x = \frac{20 \times 100}{5.12} = \frac{2000 \times 1000}{512}$$

$\therefore$ The number of people in the age group 16 – 25

$$= x \times \frac{17.75}{100}$$

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$$= \frac{2000\times100}{512}\times\frac{17.75}{100}$$

$$= \frac{2000\times100}{512}\times\frac{1775}{10000}$$

$$= \frac{20\times1775}{512}$$

$$= \frac{35500}{512} = 69.33$$

and the number of people in the age group 46 – 55

$$= x\times\frac{14.25}{100}$$

$$= \frac{2000\times100}{512}\times\frac{14.25}{100}$$

$$= \frac{2000\times1425}{512\times100} = \frac{20\times1425}{512}$$

$$= \frac{28500}{512} = 55.66$$

Hence, the required difference = 69.33 – 55.66

= 13.67 = 12.18 million (approximate)

74. Given,

The difference between the number of people in the age groups 46 – 55 and 26 – 35 = 15.75 million

$$\therefore\ x\times\frac{17.25}{100} - x\times\frac{14.25}{100} = 15.75$$

$$\Rightarrow \frac{(17.25-14.25)}{100}x = 15.75$$

$$\Rightarrow 3x = 15.75\times100$$

$$\Rightarrow x = \frac{1575}{3} = 525 \text{ million}$$

Hence, the total population of the state

= 525 million.

75. Maximum population in the state (age group 16 to 25) = 17.75%

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VERBAL

CHAPTER 1

Analogies

NUMBER ANALOGY

In number analogy also, the relationship between the given numbers is detected and then applied to the second part to find the missing numbers. This relationship between the numbers can be based on any of the following patterns : *(i)* numbers can be odd/even/prime numbers; *(ii)* numbers can be multiples of one number; *(iii)* numbers can be squares/cubes of different numbers; *(iv)* some numbers can be added to/subtracted from/multiplied to/divided into the first number to get the second number; *(v)* the second number can be the sum/product/difference of the digits of first number; and *(vi)* combinations of any mathematical calculations given above can apply to the relationship between the two given numbers.

SOLVED EXAMPLES

Directions : *Which number will come in the place of question mark?*

1. 25 : 81 : : 36 : ?

(*a*) 121 (*b*) 93 (*c*) 65 (*d*) 103

Ans. (*a*) : All the numbers are squares of different numbers.

$25 : 81 :: 36 : 121$

$\downarrow \quad \downarrow \quad \downarrow \quad \downarrow$

$5^2 \quad 9^2 \quad 6^2 \quad 11^2$

2. 36 : 18 : : 72 : ?

(*a*) 164 (*b*) 134 (*c*) 94 (*d*) 14

Ans. (*d*) : The second number is the product of digits of the first number.

$36 : 18 :: 72 : 14$

$3 \times 6 \qquad 7 \times 2$

MULTIPLE CHOICE QUESTIONS

Directions : *In the following questions, select the number from the given options which follows the same relationship as shared between the first two numbers.*

1. 1 : 11 : : 2 : ?

(*a*) 20 (*b*) 22

(*c*) 24 (*d*) 44

2. 18 : 27 : : 22 : ?

(*a*) 42 (*b*) 39

(*c*) 33 (*d*) 54

3. 14 : 20 : : 16 : ?

(*a*) 23 (*b*) 10

(*c*) 48 (*d*) 32

4. 8 : 27 : : 64 : ?

(*a*) 277 (*b*) 125

(*c*) 250 (*d*) 99

5. 0.16 : 0.0016 : : 1.02 : ?

(*a*) 10.20 (*b*) 0.102

(*c*) 0.0102 (*d*) 1.020

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6. $\frac{1}{7} : \frac{1}{14} :: \frac{1}{9} : ?$

(*a*) $\frac{1}{88}$ (*b*) $\frac{1}{80}$

(*c*) $\frac{1}{81}$ (*d*) $\frac{1}{18}$

7. 5 : 24 : : 8 : ?

(*a*) 65 (*b*) 63

(*c*) 62 (*d*) 64

8. 23 : 53 : : 8 : ?

(*a*) 66 (*b*) 57

(*c*) 27 (*d*) 19

9. 6 : 9 : : 7 : ?

(*a*) 4 (*b*) 14

(*c*) 10 (*d*) 28

10. 7 : 28 : : 2 : ?

(*a*) 8 (*b*) 16

(*c*) 24 (*d*) 12

EXPLANATORY ANSWERS

1. *(b)* : The first number is repeated to obtain the second number.

2. *(c)* : In the given set, the numbers are multiples of 9 and in the second set, multiples of 11.

18 : 27 : : 22 : 33

↓ ↓ ↓ ↓

9×2 9×3 11×2 11×3

3. *(a)* : The relationship between the numbers is :

14 : 20 : : 16 : 23

↓ ↓ ↓ ↓

7×2 $(7 \times 3) - 1$ 8×2 $(8 \times 3) - 1$

4. *(b)* : The numbers are cubes of different numbers.

8 : 27 : : 64 : 125

↓ ↓ ↓ ↓

2^3 3^3 4^3 5^3

5. *(c)* : The decimals are divided by 100.

6. *(d)* : The first fraction is multiplied by half to obtain the second fraction.

$\frac{1}{7} : \frac{1}{14} :: \frac{1}{9} : \frac{1}{18}$

$\times\frac{1}{2}$ $\times\frac{1}{2}$

7. *(b)* : The second number is square of first number minus 1.

5 : 24 : : 8 : 63

$(5^2) - 1$ $(8^2) - 1$

8. *(d)* : All the numbers are prime numbers.

9. *(c)* : The second number is three more than the first number.

6 : 9 : : 7 : 10

+3 +3

10. *(a)* : The second number is four times the first.

7 : 28 : : 2 : 8

×4 ×4

LETTER ANALOGY

In this type of analogy the relationship between two given set of letters is established and then applied to the other set to obtain the required set of letters as the answer. These letters can be moved some steps backward or forward; reversed in whole or in sections or have some common identity between each other.

SOLVED EXAMPLES

Directions : *Which set of letters will come in the place of question mark?*

1. JILK : KLIJ : : MNPQ : ?

(*a*) QNPM (*b*) MPQN (*c*) QPNM (*d*) PNMQ

Ans. (*c*) : The letters are written in reverse order to get the related set of letters.

J I L K : K L I J : : M N P Q : Q P N M

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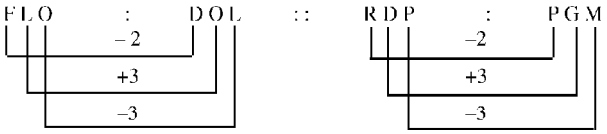
2. FLO : DOL : : RDP : ?
(*a*) PGM (*b*) MGP (*c*) GMP (*d*) MPG

Ans. (*a*) : The first and third letters are moved two and three steps backwards respectively and the second letter three steps forward.



MULTIPLE CHOICE QUESTIONS

Directions : *In the questions given below one term is missing. Based on the relationship of the two given terms find the missing term from the given options.*

1. GFC : CFG : : RPJ : ?
(*a*) JRP (*b*) JPR
(*c*) PJR (*d*) RJP

2. BCF : DEG : : MNQ : ?
(*a*) OPR (*b*) PQS
(*c*) OPP (*d*) QRT

3. NATION : ANITNO : : HUNGRY : ?
(*a*) HNUGRY (*b*) UNHGYR
(*c*) YRNGUH (*d*) UHGNYR

4. SSTU : MMNO : : AABC : ?
(*a*) GGHH (*b*) IJKK
(*c*) XXYZ (*d*) NOOP

5. ACE : FGH : : LNP : ?
(*a*) QRS (*b*) PQR
(*c*) QST (*d*) MOQ

6. UVW : SXU : : LMN : ?
(*a*) JOL (*b*) KNM
(*c*) JKL (*d*) MLO

7. EIGHTY : GIEYTH : : OUTPUT : ?
(*a*) UTOPTU (*b*) UOTUPT
(*c*) TUOUTP (*d*) TUOTUP

8. TSR : FED : : WVU : ?
(*a*) CAB (*b*) MLK
(*c*) PQS (*d*) GFH

9. CJDL : FMGR : : IKJR : ?
(*a*) OQPT (*b*) RSTU
(*c*) OQRT (*d*) KRMO

10. BOQD : ERTG : : ANPC : ?
(*a*) DQSF (*b*) FSHU
(*c*) SHFU (*d*) DSQF

11. BaBy : TaTa : : LiLy : ?
(*a*) PooL (*b*) ROse
(*c*) HaNd (*d*) DoWN

12. BCDA : STUR : : KLMJ : ?
(*a*) VWXU (*b*) EFHG
(*c*) SRTU (*d*) QSRP

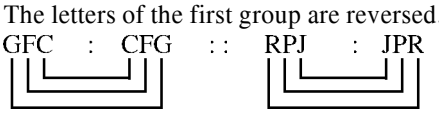
13. AEI : LPT : : CGK : ?
(*a*) OSV (*b*) RUY
(*c*) TXC (*d*) FJN

14. RUX : TRP : : BEH : ?
(*a*) SQN (*b*) QON
(*c*) QOM (*d*) QNL

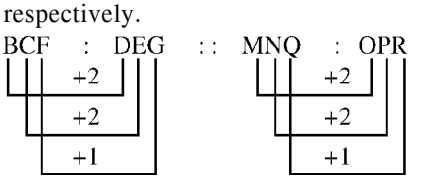
15. CART : ART : : FOUR : ?
(*a*) RUN (*b*) TWO
(*c*) QUE (*d*) OUR

EXPLANATORY ANSWERS

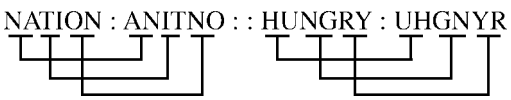
1. *(b)* : The letters of the first group are reversed.



2. *(a)* : The three letters are moved 2, 2 and 1 steps forward respectively.

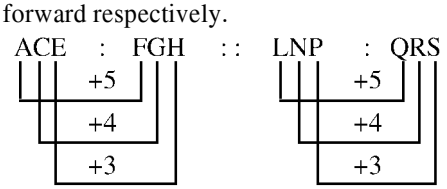


3. *(d)* : The word is divided in sections of two letters and the letters are reversed.



4. *(c)* : The first letter in each group is repeated and followed by two consecutive letters.

5. *(a)* : The three letters are moved 5, 4, and 3 steps forward respectively.



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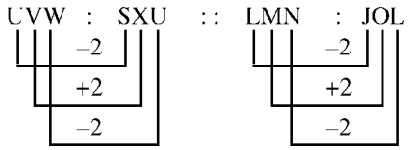
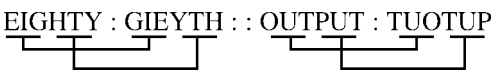
6. ***(a)*** **:** The three letters are moved –2, +2 and –2 steps respectively.

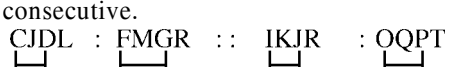


7. ***(d)*** **:** The word is divided into two sections and the letters are written backwards.

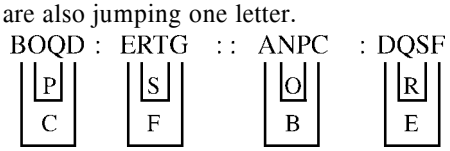


8. ***(b)*** **:** The letters are consecutive and written in reverse order.

9. ***(a)*** **:** In each set of letters, the 1st and 3rd letters are consecutive.

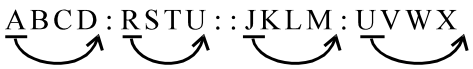


10. ***(a)*** **:** In each group, the first and fourth letters are jumping one letter and the second and third letters are also jumping one letter.

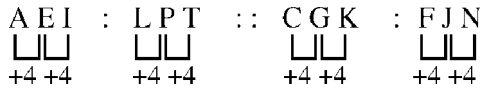


11. ***(c)*** **:** In each group the alternate letters are capitals.

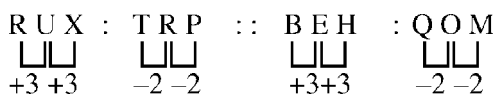
12. ***(a)*** **:** In each group the first three letters are consecutive and they follow the fourth letter.



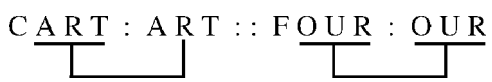
13. ***(d)*** **:** In each group the letters jump three letters between them, *i.e.,* they are moving to the fourth letter.



14. ***(c)*** **:** The letters in first set are jumping two letters, *i.e.,* moving three steps forward and in the second they are jumping one letter, *i.e.* moving two steps backward.



15. ***(d)*** **:** The first set of letters drop the first letter to get the second set.



SEMANTIC ANALOGY

In Analogy Tests the relationship between two given words is established and then applied to the other words. The type of relationship may vary, so while attempting such questions the first step is to identify the type of relationship, which can be any one of the following.

SOLVED EXAMPLES

1. Action Object Relationship

Example : Shoot is to Gun as Eat is to.....

(*a*) Hunger (*b*) Thirst (*c*) Dinner (*d*) Fruit

Ans. (*d*) : The relationship between the given words is that 'shoot' is the action and 'Gun' is the specified object of action. Similarly 'eat' is the action and 'fruit' is the specified object.

2. Association Relationship

Example : Glamour is to Stardom as Colour is to.....

(*a*) Rainbow (*b*) Shades (*c*) Art (*d*) Painting

Ans. (*d*) : As glamour is associated with stardom so is colour with painting.

3. Antonym Relationship

Example : INTROVERT : EXTROVERT

(*a*) ANGLE : TANGENT (*b*) EXTREME : INTERIM

(*c*) AGAINST : FAVOUR (*d*) ACTION : LAW

Ans. (*c*) : The related words are opposite in meaning.

4. Cause and Effect Relationship

Example : INJURY : PAIN

(*a*) GRADES : MERIT (*b*) THUNDER : LIGHTNING

(*c*) ROTATE : CHURNING (*d*) MATTER : LABOUR

Ans. (*b*) : Injury is the cause of pain and so is thunder the cause of lightning.

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5. Degree Relationship

Example : Tepid is to Hot as... is to Wail.

(*a*) Sob (*b*) Shout (*c*) Smile (*d*) Calm

Ans. (*a*) : Tepid is less hot and so also the lower degree of wail is sob.

6. Grammatical Relationship

Example: Clever is to Beautiful as Sour is to ...

(*a*) Lemon (*b*) Cunning (*c*) Loathing (*d*) Taste

Ans. (*b*) : The related words are Adjectives.

7. Obvious Relationship

Example : Mt. EVEREST : NEPAL

(*a*) MEXICO : SOUTH AMERICA (*b*) K2 : CHINA

(*c*) BIG BEN : RUSSIA (*d*) AHMEDABAD : GUJARAT

Ans. (*d*) : Mt. Everest is in Nepal and so is Ahmedabad in Gujarat.

8. Part Whole Relationship

Example : MAN : MAMMAL

(*a*) HAIL : SNOW (*b*) NATIVE : INHABITANT

(*c*) OFFSPRING : FAMILY (*d*) LIBERTY : LITERATE

Ans. (*c*) : Man is a part of the whole species of mammal so is an offspring of the whole family.

9. Purpose Relationship

Example : INSTITUTION : EDUCATION

(*a*) WAR : PEACE (*b*) HEALTH : OBESITY

(*c*) MEDICATION : RECUPERATION (*d*) BUILDING : URBANISM

Ans. (*c*) : The purpose of institution is to impart education and the purpose of medication is quick recuperation (recovery).

10. Sequence Relationship

Example : ..... is to Dusk as Summer is to Monsoon.

(*a*) Evening (*b*) Dawn (*c*) Night (*d*) Noon

Ans. (*a*) : Summer season is immediately followed by monsoon (rainy season) and evening is immediately followed by dusk.

11. Synonym Relationship

Example : INDENT : REQUEST

(*a*) REPLICA : CHEAT (*b*) DOLE : ALMS

(*c*) DISMAL : DUNCE (*d*) EXACT : CHECK

Ans. (*b*) : The related words have the same meaning.

12. Volume Relationship

Example : GALLONS : SWIMMING POOL

(*a*) SPECTATORS : AUDITORIUM (*b*) CURRENCY : SHARES

(*c*) DUST : MOUNTAIN (*d*) BOOKS : CATALOGUE

Ans. (*a*) : Gallons of water is needed to fill a swimming pool and large number of spectators can be admitted into an auditorium.

MULTIPLE CHOICE QUESTIONS

Directions : *In the questions given below establish the relationship between the two words. Then from the given options select one which has the same relationship as of the given two words.*

1. HUNGER : FOOD : : THIRST : ?

(*a*) Water (*b*) Drink

(*c*) Tea (*d*) Coffee

2. HUNTER : GUN : : WRITER : ?

(*a*) Book (*b*) Pen

(*c*) Poem (*d*) Page

3. WOOL : SHEEP : : SILK : ?

(*a*) Saree

(*b*) String

(*c*) Silkworm

(*d*) Moth

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4. FOOD : STOMACH : : FUEL : ?
(*a*) Engine (*b*) Automobile
(*c*) Rail (*d*) Aeroplane

5. WATER : SAND : : OCEAN : ?
(*a*) Island (*b*) River
(*c*) Desert (*d*) Waves

6. ADULT : BABY : : FLOWER : ?
(*a*) Seed (*b*) Bud
(*c*) Fruit (*d*) Butterfly

7. WRITER : READER : : PRODUCER : ?
(*a*) Creator (*b*) Contractor
(*c*) Creature (*d*) Consumer

8. ENTRANCE : EXIT : : LOYALTY : ?
(*a*) Treachery (*b*) Patriotism
(*c*) Fidelity (*d*) Reward

9. MOTHER : MATERNAL : : FATHER : ?
(*a*) Eternal (*b*) Detrimental
(*c*) Paternal (*d*) Formidable

10. PEARL : NECKLACE : : FLOWER : ?
(*a*) Plant (*b*) Garden
(*c*) Petal (*d*) Bouquet

11. ALPHABET : WORD : : WORD : ?
(*a*) Sound (*b*) Music
(*c*) Sentence (*d*) Dictionary

12. LIFE : DEATH : : HOPE : ?
(*a*) Cry (*b*) Pain
(*c*) Despair (*d*) Sad

13. GOOD : BAD : : VIRTUE : ?
(*a*) Blame (*b*) Sin
(*c*) Despair (*d*) Vice

14. BIRD : FLY : : SNAKE : ?
(*a*) Timid (*b*) Clatter
(*c*) Crawl (*d*) Hole

15. CAT : MOUSE : : BIRD : ?
(*a*) Cage (*b*) Trap
(*c*) Eagle (*d*) Worm

16. STATE : EXILE
(*a*) Police : Arrest
(*b*) Judge : Convict
(*c*) Constitution : Amendment
(*d*) Church : Excommunicate

17. CAPRICIOUSNESS : RELIABILITY
(*a*) Extemporaneous : Predictability
(*b*) Unreliable : Inhuman
(*c*) Tenacious : Practicality
(*d*) Arbitrary : Whimsical

18. LOATH : COERCION
(*a*) Detest : Caressing (*b*) Irritate : Caressing
(*c*) Irate : Antagonism (*d*) Reluctant : Persuasion

19. SCALES : FISH
(*a*) Lady : Dress (*b*) Tree : Leaves
(*c*) Bird : Feather (*d*) Skin : Man

20. TREE : SAPLING
(*a*) Hut : Mansion (*b*) Giant : Dwarf
(*c*) Horse : Foal (*d*) Ant : Elephant

EXPLANATORY ANSWERS

1. ***(a)*** **:** Hunger is satiated by food, thirst by water.

2. ***(b)*** **:** Weapon of a hunter is a gun, weapon of a writer is a pen.

3. ***(c)*** **:** Wool is obtained from sheep, silk is obtained from silkworm.

4. ***(a)*** **:** Food is consumed in stomach, fuel is consumed in engine.

5. ***(c)*** **:** The related words are near opposites.

6. ***(b)*** **:** The youngone of an adult is a baby and that of a flower is a bud.

7. ***(d)*** **:** A writer aims to please the readers by his writings, a producer aims to please the consumers by his products.

8. ***(a)*** **:** The related words are opposites.

9. ***(c)*** **:** Relations on the mother's side are maternal and on the father's side paternal.

10. ***(d)*** **:** Many pearls make a necklace, many flowers make a bouquet.

11. ***(c)*** **:** More than one alphabet make a word, more than one word make a sentence.

12. ***(c)*** **:** The related words are opposites.

13. ***(d)*** **:** The related words are opposites.

14. ***(c)*** **:** Birds fly, snakes crawl.

15. ***(d)*** **:** Cat chases the mouse, bird chases the worm.

16. ***(d)*** **:** Punishment of leaving the State is exile, punishment of leaving the Church is excommunication.

17. ***(c)*** **:** The related words are antonyms

18. ***(d)*** **:** Loathing is the result of constant coersion, reluctance is the result of constant persuasion.

19. ***(d)*** **:** Covering of the fish is scales, covering of man is skin.

20. ***(c)*** **:** Young tree is a sapling, young horse is a foal.

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CHAPTER 2

Number Classification

ODD ONE OUT—NUMBERS

In this type of classification, different numbers are given as options. These numbers have some commonness; except one which is the odd one. One has to identify the similarity and then strike the odd one out as answer option. The number can be odd/even/consecutive, prime numbers, multiple of some number, single, square or cubes of different numbers, plus/minus of some other number or combinations of any mathematical calculation.

SOLVED EXAMPLES

Directions : *Find the odd number from the given options.*

1. (*a*) 62 (*b*) 121 (*c*) 36 (*d*) 256

Ans. ***(a)*** **:** The other numbers are squares of :

11, (= 121), 6 (= 36) and 16 (= 256)

2. (a) 27 (b) 132 (c) 93 (d) 154

Ans. ***(d)*** **:** All other numbers are divisible by 3.

MULTIPLE CHOICE QUESTIONS

Directions : *In each of the following questions, there are four options. Three numbers, in these options, are alike in certain manner. Only one number does not fit in. Choose the one which is different from the rest.*

1. (*a*) 1948 (*b*) 2401
(*c*) 966 (*d*) 1449

2. (*a*) 182 (*b*) 169
(*c*) 130 (*d*) 158

3. (*a*) 129 (*b*) 130
(*c*) 131 (*d*) 132

4. (*a*) 3215 (*b*) 9309
(*c*) 4721 (*d*) 2850

5. (*a*) 1776 (*b*) 2364
(*c*) 1976 (*d*) 3776

6. (*a*) 64 (*b*) 84
(*c*) 16 (*d*) 36

7. (*a*) 24 (*b*) 90
(*c*) 54 (*d*) 36

8. (*a*) 7658 (*b*) 1234
(*c*) 9876 (*d*) 6543

9. (*a*) 3 (*b*) 9
(*c*) 5 (*d*) 7

10. (*a*) 6450 (*b*) 1776
(*c*) 2392 (*d*) 3815

11. (*a*) 24 (*b*) 48
(*c*) 42 (*d*) 12

12. (*a*) 616 (*b*) 252
(*c*) 311 (*d*) 707

13. (*a*) 18 (*b*) 12
(*c*) 30 (*d*) 20

14. (*a*) 3730 (*b*) 6820
(*c*) 5568 (*d*) 4604

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EXPLANATORY ANSWERS

1. (*a*) : Other numbers are divisible by 7.
2. (*d*) : Other numbers are multiples of 13.
3. (*c*) : 131 is a prime number.
4. (*b*) : In other numbers, no digit is repeated.
5. (*b*) : In other numbers the last two digits are same.
6. (*b*) : All other numbers are perfect squares.
7. (*a*) : In other numbers, the sum of both the digits is 9.
8. (*a*) : In others, the digits are consecutive in natural or reverse series.
9. (*b*) : All others are prime numbers.
10. (*d*) : All other numbers are divisible by 2.
11. (*c*) : All other numbers are multiples of 12.
12. (*c*) : In other numbers, the first and last digits are same.
13. (*a*) : The other numbers are $3^2 + 3 = 12$, $5^2 + 5 = 30$, $4^2 + 4 = 20$, $6^2 + 6 = 42$
14. (*b*) : In all other numbers, two digits are same.

ODD ONE OUT—LETTERS

In this classification of letters, four groups of letters or a series of letters is given as options. One has to select the option as answer which does not share the commonness of the others.

SOLVED EXAMPLES

Directions : *Find the odd one out in the following letters :*

1. (*a*) NOP (*b*) RTU (*c*) JKL (*d*) EFG
Ans. *(b)* : In each group the letters are consecutive. In this option the first two letters jump one letter (S) inbetween.

2. (*a*) RUX (*b*) CFI (*c*) BDG (*d*) FIL
Ans. *(c)* : In each group, the difference between the letters is same. In this option B and D jump one letter and D and G jump two letters.

MULTIPLE CHOICE QUESTIONS

Directions : *In each of the following questions, four out of five alternatives contain alphabet placed in a particular form. Find the one that does not belong to the group.*

1. (*a*) BXCW (*b*) OTPS (*c*) GQHR (*d*) JNKM
2. (*a*) BVPS (*b*) OLMZ (*c*) RPSR (*d*) XTCD
3. (*a*) RNJH (*b*) SOKG (*c*) QMIE (*d*) MIEA
4. (*a*) QLJS (*b*) GVTI (*c*) KRPM (*d*) ONMP
5. (*a*) PEAR (*b*) TORE (*c*) REAP (*d*) TEAR
6. (*a*) ECA (*b*) JHF (*c*) OMK (*d*) UWY
7. (*a*) ACE (*b*) PRT (*c*) UWY (*d*) MNO
8. (*a*) WVU (*b*) NML (*c*) HGF (*d*) DBA
9. (*a*) ABD (*b*) FGI (*c*) LMO (*d*) STU
10. (*a*) CDE (*b*) JKL (*c*) PQS (*d*) TUV

EXPLANATORY ANSWERS

1. (*c*) : In all other groups, first and third letters are consecutive and second and fourth letters are in reverse alphabetical order.
2. (*c*) : No letter is repeated in any other group.
3. (*a*) : In all other groups, there is a gap of three letters between two consecutive letters.
4. (*d*) : In all other groups, first and third letters are moved two steps forward to obtain fourth and second letters respectively.
5. (*b*) : All other groups contain E, A and R.
6. (*d*) : All other groups contain alternate letters from right to left.

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7. (*d*) : All other groups contain alternate letters from left to right.

8. (*d*) : In all others, the three letters are consecutive but in reverse order.

9. (*d*) : In all others, the first two letters are consecutive and third letter is obtained by skipping one letter from the second.

10. (*c*) : In all other, the three letters are consecutive.

ODD ONE OUT—WORDS

In this type of classification, five words are given out of which four are almost same in matter or meaning and only one word is different from the common four. One has to find out the word which is different from the rest.

SOLVED EXAMPLES

Directions : *In the following questions spot the odd one out.*

1. (a) Father (b) Mother (c) Friend (d) Brother

Ans. *(c)* : All other are blood relations.

2. (a) Water (b) Jelly (c) Lemonade (d) Coffee

Ans. *(b)* : All other are liquids.

MULTIPLE CHOICE QUESTIONS

Directions : *In each of the following questions, four words are alike in some manner. Spot the odd one out.*

1. (*a*) Green (*b*) Red (*c*) Colour (*d*) Orange

2. (*a*) Stable (*b*) Hole (*c*) Canoe (*d*) Sty

3. (*a*) Nose (*b*) Eyes (*c*) Skin (*d*) Teeth

4. (*a*) Venus (*b*) Moon (*c*) Pluto (*d*) Mars

5. (*a*) Happy (*b*) Gloomy (*c*) Lively (*d*) Cheerful

6. (*a*) Cone (*b*) Circle (*c*) Triangle (*d*) Rectangle

7. (*a*) Lead (*b*) Mercury (*c*) Copper (*d*) Iron

8. (*a*) Kite (*b*) Bird (*c*) Radar (*d*) Jet

9. (*a*) Knee (*b*) Shoulder (*c*) Ankle (*d*) Palm

10. (*a*) Deluge (*b*) Calamity (*c*) Catastrophe (*d*) War

11. (*a*) Cub (*b*) Chicken (*c*) Pig (*d*) Pup

12. (*a*) Rabbit (*b*) Crocodile (*c*) Earthworm (*d*) Snail

13. (*a*) Tree (*b*) Leaf (*c*) Bush (*d*) Herb

14. (*a*) Doctor (*b*) Teacher (*c*) Engineer (*d*) Diver

15. (*a*) Trot (*b*) Equestrian (*c*) Derby (*d*) Grunt

EXPLANATORY ANSWERS

1. *(c)* : All others are types of colour.

2. *(c)* : Canoe is a boat. Others are resting places of birds/ animals.

3. *(d)* : All others are sense organs.

4. *(b)* : All others are planets.

5. *(b)* : All others are expressions of joy

6. *(a)* : All others are geometrical figures.

7. *(b)* : All others are solid metals.

8. *(c)* : All others are flying objects. Radar traces the objects in sky.

9. *(d)* : All others are joints in human body.

10. *(d)* : All others are nature-bound. Only war is man-made.

11. *(c)* : All others are young ones of animals.

12. *(a)* : All others are crawling animals.

13. *(b)* : All others are types of vegetation.

14. *(d)* : All others are professions, but only Diver's profession comprises of diving under water.

15. *(d)* : All other terms are related with activities of a horse.

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Small & Capital Letters/ Numbers Coding-Decoding and Classification

TYPE - I

Coding is a secretive language which is used to change the representation of the actual term/word/value. This coded language can be framed by *(i)* moving the letters one or more steps forward or backward; *(ii)* substituting numbers for letters and vice–versa; *(iii)* writing the letters of the given word in reverse order in part or in whole; and *(iv)* replacing the letters in their natural series by the same positioned letters in their reverse series.

Alphabet in natural series are :

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
↓				↓					↓					↓					↓						↓	
1st				5th					10th					15th					20th						25th	

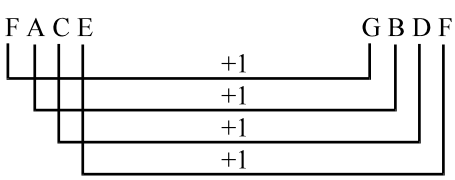
Alphabet in reverse series are :

Z	Y	X	W	V	U	T	S	R	Q	P	O	N	M	L	K	J	I	H	G	F	E	D	C	B	A
↓				↓					↓					↓					↓						↓	
1st				5th					10th					15th					20th						25th	

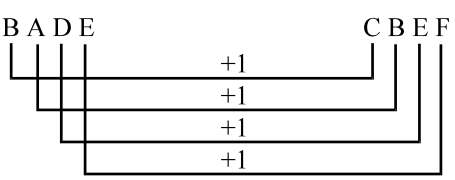
Note : On reaching Z, the series restarts from A and on reaching A, it restarts from Z.

SOLVED EXAMPLES

1. If FACE is coded as GBDF, then BADE will be coded as :
(*a*) CBEF (*b*) CEBF (*c*) CFBE (*d*) CBFE
Ans. ***(a)*** **:** The word is coded by moving the letters one step forward.



Similarly,



2. If RESULT is coded as 798206, LET will be coded as :
(*a*) 680 (*b*) 092 (*c*) 096 (*d*) 086
Ans. ***(c)*** **:** The letters are coded by numbers, and to code the given word, select the respective coded numbers.

R E S U L T	→	letters
7 9 8 2 0 6	→	code

So, code for LET will be

L E T	→	letters
0 9 6	→	code

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MULTIPLE CHOICE QUESTIONS

Directions : *In the following questions select the right option which indicates the correct code for the word or letter given in the question.*

1. If CHAIR is coded as FKDLU then RAID is coded as :
(*a*) ULGD (*b*) ULKG
(*c*) ULDG (*d*) UDLG

2. If CONDEMN is coded as CNODMEN, then TEACHER is coded as :
(*a*) TEACHER (*b*) TAEECHR
(*c*) TCAEEHR (*d*) TAECEHR

3. In a code language COME is written as XLNV and ABLE as ZYOV. How will MOLLY be written in that code?
(*a*) NLOBO (*b*) NLBOO
(*c*) LNOOB (*d*) NLOOB

4. In a certain code PROFESSION is written as EFORPNOISS. In the same code DICTIONARY will be written as :
(*a*) YRANOITCID (*b*) ITCIDYRANO
(*c*) ITCIDYRNAO (*d*) ITCDIYARNO

5. JUNE is coded as NXPF, how will STAY be coded in the same manner?
(*a*) WWCZ (*b*) WVCZ
(*c*) WWDB (*d*) VWZC

6. If in a certain code GENIUS is coded as IGPKWU, then IDIOT will be written in the same code as :
(*a*) JEJPU (*b*) KFKQV
(*c*) LGLRW (*d*) HCHNS

7. If ACTION is coded as ZXGRLM, then HEALTH will be coded in the same way as :
(*a*) SVZOGS (*b*) TVZOGT
(*c*) RUZPGR (*d*) QVGOZQ

8. If THOUSAND is coded as SGNTRZMC, then FUMING will be coded as :
(*a*) GVNJOH (*b*) ETHLMF
(*c*) EVLJMH (*d*) ETLHMF

9. If EARTHQUAKE is coded as MOGPENJOSM, then EQUATE will be coded as :
(*a*) MENOPM (*b*) MENOMP
(*c*) MJOGPM (*d*) MNJOPM

10. In a certain code language HJIZT code is deciphered as MONEY, in the same way NOVGZ will be deciphered as :
(*a*) STUMP (*b*) STALE
(*c*) STICK (*d*) SPIRE

11. If in a certain code JOSEPH is coded as FKOALD, then GEORGE will be coded in the same way as :
(*a*) CBJNCA (*b*) CANKCA
(*c*) CAKNCA (*d*) CAKCNA

12. If COUNTRY is coded in a certain way as EMWLVPA, ELECTORATE will be coded in the same manner as :
(*a*) CJCEVQPYWC (*b*) GJGERQTYVG
(*c*) CNCERQPCRG (*d*) GJGAVMTYVC

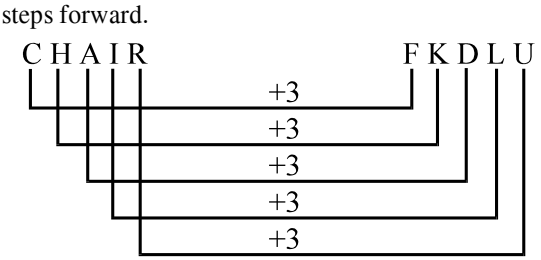
13. In a certain code PORTUGESE is written as ESEGUTROP, MALAYALAM will be written in the same code as :
(*a*) MALAYALAM (*b*) MALYALAM
(*c*) MALAYALM (*d*) MALAYLAM

14. If PHILOSOPHY is coded as HPLISOPOYH, ORNAMENTAL will be coded as :
(*a*) ROANEMNTLA (*b*) ONRAMNEALT
(*c*) ROANEMTNLA (*d*) ROANEMNATL

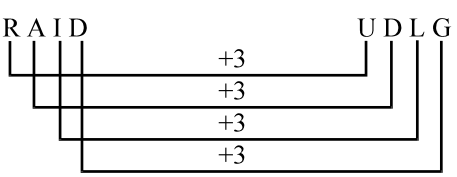
15. If SABOTAGE is coded as UADOVAIE, how will EMERGENCY be coded in the same manner?
(*a*) GMGRIEPCA (*b*) GMGRGEPCA
(*c*) BNBQFDOBZ (*d*) EOETGGNEY

EXPLANATORY ANSWERS

1. ***(d)*** **:** The word is coded by moving the letters three steps forward.



Similarly,



2. ***(d)*** **:** In this word, the second and third letters interchange their places and the fifth and sixth letters do the same. Other letters retain their position.

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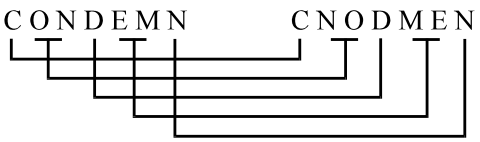

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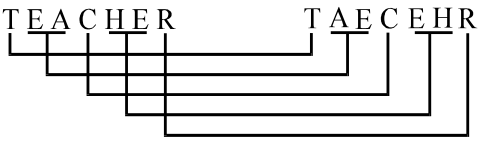


3. *(d)* : The letters of the word are coded by their represented letters in the reverse series.

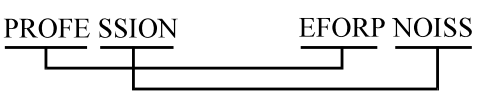
C O M E → letters in natural series
X L N V → letters in reverse series
↓ ↓ ↓ ↓
3rd 15th 13th 5th → position of letters

A B L E → letters in natural series
Z Y O V → letters in reverse series
↓ ↓ ↓ ↓
1st 2nd 12th 5th → position of letters

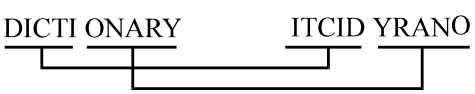
Similarly,

M O L L Y → letters in natural series
N L O O B → letters in reverse series
↓ ↓ ↓ ↓ ↓
13th 15th 12th 12th 25th → position of letters

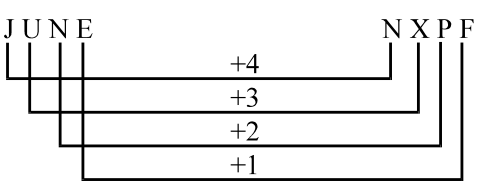
4. *(b)* : The word is divided into two equal parts and the letters of each part are written backwards.



Similarly,



5. *(a)* : The word is coded by moving the letters +4, +3, +2, and +1 steps respectively.



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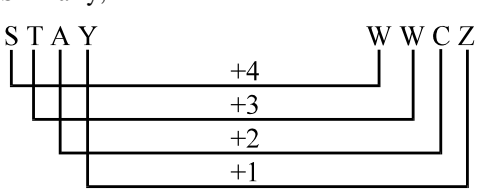
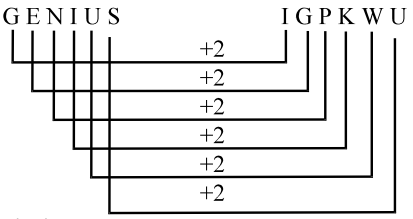


6. *(b)* : The word is coded by moving the letters two steps forward, *i.e.,*



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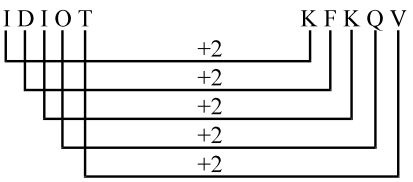


7. *(a)* : The letters of the word are coded by their represented letters in the reverse series.

A C T I O N → letters in natural series

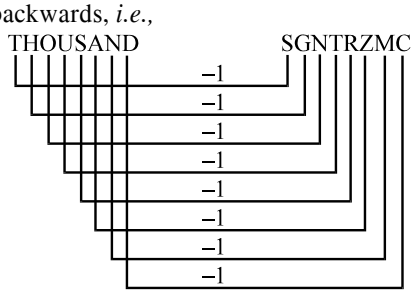
Z X G R L M → letters in reverse series
↓ ↓ ↓ ↓ ↓ ↓
1st ↓ 20th ↓ 15th ↓ position of
3rd 9th 14th letters

Similarly,

H E A L T H → letters in natural series

S V Z O G S → letters in reverse series
↓ ↓ ↓ ↓ ↓ ↓
8th ↓ 1st ↓ 20th ↓ → position of
5th 12th 8th letters

8. *(d)* : The word is coded by moving the alphabet one step backwards, *i.e.,*



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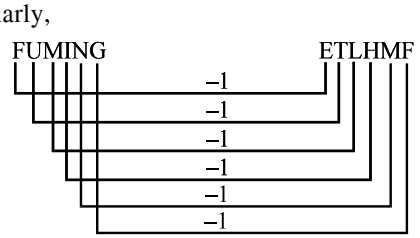

9. *(d)* : The alphabet in word EQUATE are taken from the given word EARTHQUAKE. Tally the letters from the coded word to get the answer code.

E A R T H Q U A K E → letters
M O G P E N J O S M → codes
E Q U A T E → letters to be coded
M N J O P M → answer codes

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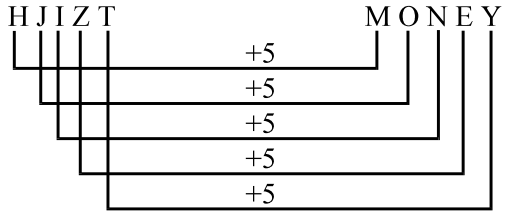
10. ***(b)*** **:** The coded alphabet are deciphered by moving five steps forward, *i.e.,*



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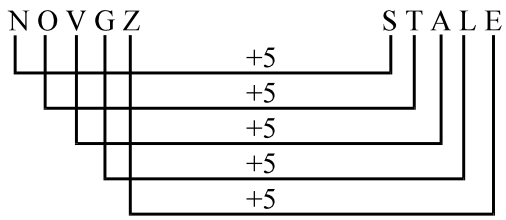
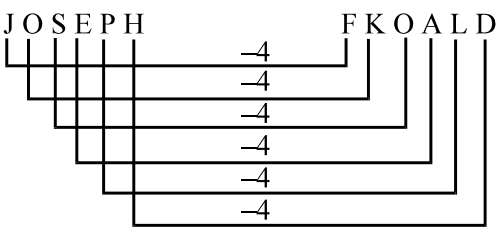


11. ***(c)*** **:** The word is coded by moving the alphabet four steps backward, *i.e.,*



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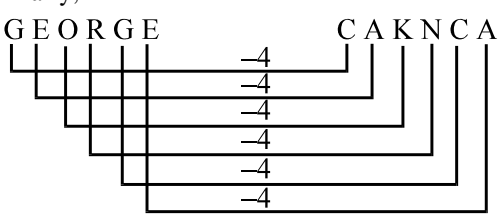
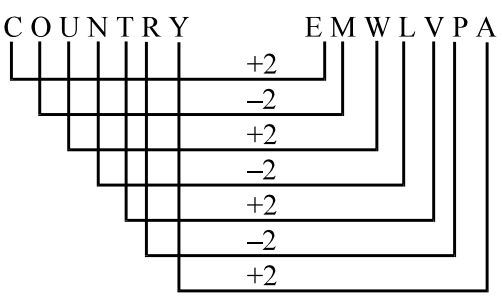


12. ***(d)*** **:** The word is coded by moving the alphabet two steps forward and two steps backward alternately, *i.e.,*



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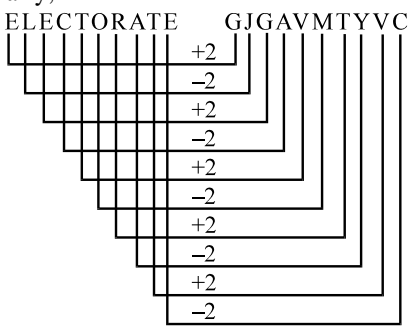
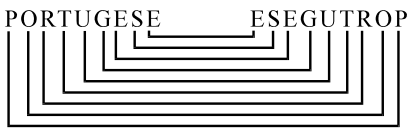


13. ***(a)*** **:** The coded word is the alphabet of the word written backwards.



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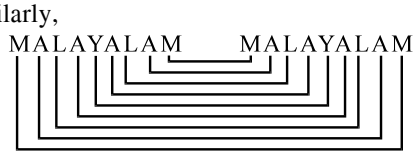
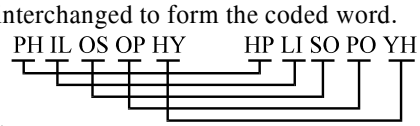


14. ***(c)*** **:** The places of two consecutive letters in the word are interchanged to form the coded word.



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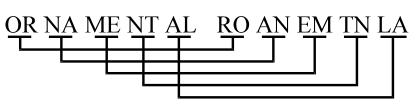
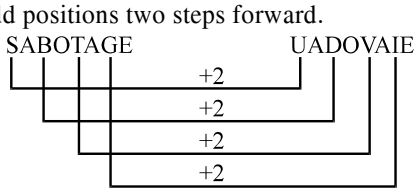


15. ***(a)*** **:** The word is coded by moving only the alphabet at odd positions two steps forward.



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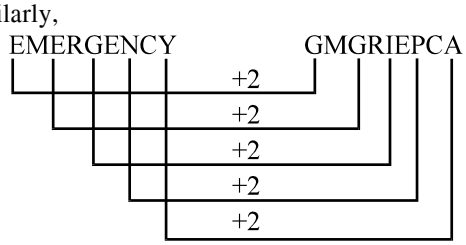

TYPE - II

Column coding is a very complex form of coding. It needs a lot of attention and swift eye movement to decode the code for each letter of the given words. Proper words in capital letters are given in one column and the codes in small letters are given in another column. Based on the information given in both columns the candidate has to arrive at the correct answer option.

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MULTIPLE CHOICE QUESTIONS

Directions: *The following questions are based on the column pattern. Understand the coding pattern and answer the questions.*

	Column I	Column II
(1)	FAMOUS	(a) jcqhxp
(2)	SATIRE	(b) hqdbyn
(3)	FRIGHT	(c) ybcnke
(4)	TANGLE	(d) zewhnd
(5)	ROVING	(e) epbmyw
(6)	HUNTER	(f) wdnbxk

1. What is the code used for the letter U?
(*a*) d (*b*) n
(*c*) b (*d*) x

2. What is the code used for the letter N?
(*a*) e (*b*) p
(*c*) m (*d*) w

3. What is the code used for the letter A?
(*a*) h (*b*) q
(*c*) b (*d*) n

4. What is the code used for the letter F?
(*a*) w (*b*) p
(*c*) d (*d*) c

5. What is the code used for the letter E?
(*a*) d (*b*) n
(*c*) b (*d*) k

	Column I	Column II
(1)	WRONG	(a) cklxd
(2)	GRANT	(b) pdqkc
(3)	STEAM	(c) qpuns
(4)	CROWS	(d) lxnvk
(5)	CEMET	(e) usqvs
(6)	TERMS	(f) nukqs

6. What is the code used for the letter N?
(*a*) c (*b*) x
(*c*) l (*d*) n

7. What is the code used for the letter M?
(*a*) v (*b*) q
(*c*) u (*d*) s

8. What is the code used for the letter W?
(*a*) d (*b*) x
(*c*) c (*d*) p

9. What is the code used for the letter G?
(*a*) k (*b*) c
(*c*) s (*d*) d

10. What is the code used for the letter S?
(*a*) n (*b*) s
(*c*) d (*d*) k

	Column I	Column II
(1)	HOUSE	(a) lfyqx
(2)	PAGES	(b) pyfgm
(3)	LUNGS	(c) nhmzf
(4)	PHONE	(d) xqygh
(5)	LANDS	(e) hofzp
(6)	HOUND	(f) qnoxh

11. What is the code used for the letter O?
(*a*) h (*b*) g
(*c*) q (*d*) x

12. What is the code used for the letter E?
(*a*) n (*b*) y
(*c*) p (*d*) m

13. What is the code used for the letter G?
(*a*) p (*b*) o
(*c*) f (*d*) m

14. What is the code used for the letter N?
(*a*) l (*b*) y
(*c*) x (*d*) h

15. What is the code used for the letter D?
(*a*) o (*b*) z
(*c*) g (*d*) p

EXPLANATORY ANSWERS

1. (*d*) : From statements (1) and (6), U = X.

2. (*d*) : From statements (5) and (6), RN = bw. From statement (4), N = w.

3. (*a*) : From statements (2) and (4), ATE = hdn. From statement (6), TE = dn. Therefore, A = h.

4. (*d*) : From statements (1) and (3), F = c.

5. (*a*) : From statements (2) and (4), ATE = hdn. From statement (6), TE = dn. From statement (3), T = n. Hence E = d.

6. (*a*) : From statements (1) and (2), N = C.

7. (*c*) : From statements (3), (5) and (6), M = u.

8. (*b*) : From statements (1) and (4), W = x.

9. (*d*) : From statements (1) and (2), G = d.

10. (*a*) : From statements (3), (4) and (6), S = n.

11. (*d*) : From statements (1), (4) and (6), O = x.

12. (*b*) : From statements (1), (2) and (4), E = y.

13. (*d*) : From statements (2) and (3), G = m.

14. (*d*) : From statements (3), (4), (5) and (6), N = h.

15. (*a*) : From statements (5) and (6), D = o.

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TYPE - III

There is variety in ways of coding. Coding language is not only for words and numbers but also for hiding a group of words, statements or even sentences. This form of coding pattern may appear to be confusing but after solving only a few questions it is very easy to understand. Questions based on this coding pattern require no moving of steps or straining efforts of calculations, but only quick tallying or comparing ability. The codes can be letters or numbers.

SOLVED EXAMPLE

In a certain code 'ra mei ket' means 'he is rich'; 'rui pha jeu' means 'run for money'; and 'pha rui ket' means 'money for rich'. Which of the following is the code for 'rich'?

(*a*) ra (*b*) pha
(*c*) ket (*d*) jeu

Ans. *(c)* : The given information is :

	Code	*Sentence*
1.	ra mei *ket*	he is *rich*
2.	rui pha jeu	run for money
3.	pha rui *ket*	money for *rich*

After comparing codes and sentences 1 and 3, it is clear that word 'rich' is common and so is the code 'ket'.

MULTIPLE CHOICE QUESTIONS

Directions : *In the following questions study the coded patterns and then select the right option from the given alternatives.*

1. In a certain language, (a) 'go ju mi' stands for 'plenty of money'; (b) pao ju go nei vu' for 'money creates lots of problems'; (c) 'kol vu nei' for 'problems create tension'; and (d) 'sol tun ju haw' for 'still money is needed'. Which of the following words stand for 'money'?

(*a*) nei (*b*) ju
(*c*) haw (*d*) go

2. In a certain language, (a) 'FOR' stands for 'old is gold'; (b) 'ROT' stands for 'gold is pure'; (c) 'ROM' stands for 'gold is costly'. How will 'pure old gold is costly' be written?

(*a*) TFROM (*b*) FOTRM
(*c*) FTORM (*d*) TOMRF

3. In a certain code '415' means 'milk is hot'; '18' means 'hot soup'; and '895' means 'soup is tasty'. What number will indicate the word 'tasty'?

(*a*) 9 (*b*) 8
(*c*) 5 (*d*) 4

4. In a certain code '643' means 'she is beautiful', '593' means 'he is handsome', and '567' means 'handsome meets beautiful'. What number will indicate the word 'meets'?

(*a*) 5 (*b*) 3
(*c*) 7 (*d*) 6

5. In a certain code language, (a) 'dugo hui mul zo' stands for 'work is very hard'; (b) 'hui dugo ba ki' for 'Bingo is very smart'; (c) 'nano mul dugo' for 'cake is hard', and (d) 'mul ki qu' for 'smart and hard'. Which of the following words stand for 'Bingo'?

(*a*) jalu (*b*) dugo
(*c*) ki (*d*) ba

6. In a certain code language, (a) 'pic vic nic' stands for 'winter is cold'; (b) 'to nic re' for 'summer is hot'; (c) 're pic boo' for 'winter and summer' and (d) 'vic tho pa' for 'nights are cold'. Which of the following word is the code for 'summer'?

(*a*) nic (*b*) boo
(*c*) to (*d*) re

7. In a certain language, (a) 'mx das sci' means 'good little frock'; (b) 'jm coz sci' means 'girl behaves good'; (c) 'ngv drs coz' means 'girl makes mischief'; and (d) 'das gp coz' means 'little girl fell'. What is the code for 'frock' in this language?

(*a*) mx (*b*) das
(*c*) sci (*d*) gp

8. In a certain language 'mu mit es' means 'who is she' and 'elb mu es' means 'where is she'. What is the code for 'where' in this language?

(*a*) es (*b*) elb
(*c*) mu (*d*) mit

9. In a certain code language '069' means 'grapes are sweet', '476' means 'very sweet fruit' and '509' means 'grapes are ripe'. Which of the following digits means 'ripe' in that language?

(*a*) 0 (*b*) 5
(*c*) 9 (*d*) 7

10. In a certain code language 'roi ja kyo twa' means 'Moody is writing letters', 'pok ju ja twa' means 'Woody is writing cards', 'trn kyo pos un' means 'they are writing letters', and 'koi rus pok' means 'gifts and cards'. What is the code word for 'Moody'?

(*a*) ja (*b*) twa
(*c*) roi (*d*) kyo

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EXPLANATORY ANSWERS

1. (*b*) :

	Code	*Sentence*
1.	go *ju* mi	plenty of *money*
2.	pao *ju* go nei vu	*money* creates lots of problems
3.	kol vu nei	problems create tension
4.	sol tun *ju* haw	still *money* is needed

In 1st, 2nd and 4th codes and their sentences the word 'ju' is repeated and so is 'money'.

2. (*a*) :

	Code	*Sentence*
1.	FOR	old is gold
2.	ROT	gold is pure
3.	ROM	gold is costly

Therefore,

F	stands	for	old
O	stands	for	is
R	stands	for	gold
T	stands	for	pure
M	stands	for	costly

So, 'pure old gold is costly' will be written as 'TFROM'.

3. (*a*) :

	Code	*Sentence*
1.	415	milk is hot
2.	18	hot soup
3.	895	soup is *tasty*

From 3rd code and its sentence neither number '9' is repeated nor the word 'tasty'.

4. (*c*) :

	Code	*Sentence*
1.	643	she is beautiful
2.	593	he is handsome
3.	567	handsome *meets* beautiful

From 3rd code and its sentence, neither number '7' nor the word 'meets' is repeated.

5. (*d*) :

	Code	*Sentence*
1.	*dugo hui* mul zo	work *is very* hard
2.	*hui dugo* **ba** *ki*	**Bingo** *is very smart*
3.	nano mul *dugo*	cake is *hard*
4.	mul *ki* qu	*smart* and hard

From 2nd code and its sentence, neither 'ba' nor 'Bingo' is repeated.

(Words repeated are in italics)

6. (*d*) :

	Code	*Sentence*
1.	pic vic nic	winter is cold
2.	to nic *re*	*summer* is hot
3.	*re* pic boo	winter and *summer*
4.	vic tho pa	nights are cold

The word 'summer' is common in 2nd and 3rd sentences and so is the code 're'.

7. (*a*) :

	Code	*Sentence*
1.	**mx** *das sci*	*good little* **frock**
2.	jm coz *sci*	girl behaves *good*
3.	ngv drs coz	girl makes mischief
4.	*das* gp coz	*little* girl fell

Word 'frock' is only in the 1st sentence. The code word 'das' is repeated in 4th sentence and 'sci' in 2nd sentence. So, 'mx' is the code for 'frock'.

8. (*b*) :

	Code	*Sentence*
1.	*mu* mit *es*	who *is she*
2.	**elb** *mu* es	**where** *is she*

The code words 'mu' and 'es' are repeated in Ist sentence. The only code left is 'elb' which means 'where'.

9. (*b*) :

	Code	*Sentence*
1.	*069*	*grapes are* sweet
2.	476	very sweet fruit
3.	**5***09*	*grapes are* **ripe**

The code numbers '0' and '9' are repeated in 1st and 3rd sentences. The only code remaining is '5' which stands for 'ripe'.

10. (*c*) :

	Code	*Sentence*
1.	**roi** *ja kyo twa*	**Moody** *is writing letters*
2.	pok ju *ja twa*	Woody *is writing* cards
3.	trn *kyo* pos un	they are writing *letters*
4.	koi rus pok	gifts and cards

'Moody' is in 1st sentence only. The code words 'ja' and 'twa' are repeated in 2nd sentence and 'kyo' in 3rd sentence. Only code word 'roi' remains which stands for 'Moody'.

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Semantic Series

MULTIPLE CHOICE QUESTIONS

1. ADG, XVT, BEH, WUS, ?
(*a*) VTR (*b*) CFI
(*c*) DFJ (*d*) STU

2. GMSY, IOUA, KQWC, ?
(*a*) MSYE (*b*) NSYE
(*c*) MTYE (*d*) MSYF

3. ADG, GJM, ?, SVY
(*a*) MPS (*b*) MQR
(*c*) MQS (*d*) SPM

4. KNQ, TWZ, CFI, ?
(*a*) KOR (*b*) LOR
(*c*) MNQ (*d*) JLM

5. AEI, BFJ, CGK, ?
(*a*) DLH (*b*) EGF
(*c*) EFL (*d*) DHL

6. CFI, IKM, OPQ, ?
(*a*) UUU (*b*) UST
(*c*) VUS (*d*) TUV

7. LAZ, NEX, PIV, ?
(*a*) SLS (*b*) QNS
(*c*) RMT (*d*) RMS

8. DED, EFE, FGF, ?
(*a*) HGH (*b*) GHG
(*c*) EFE (*d*) FHF

9. XYZ, UVW, ?, OPQ
(*a*) RST (*b*) STU
(*c*) QRS (*d*) TUV

10. VCL, UEI, TGF, ?
(*a*) SJC (*b*) THI
(*c*) SIC (*d*) RHD

11. ABC, EFG, HIJ, ?
(*a*) IJK (*b*) KLM
(*c*) LMN (*d*) JKL

12. PQR, HIJ, DEF, ?
(*a*) DEF (*b*) CDE
(*c*) ABC (*d*) BCD

13. KNQ, TWZ, CFI, ?
(*a*) MNQ (*b*) LOR
(*c*) LPR (*d*) KOR

14. JOBS, KMEO, LKHK, ?, NGNC
(*a*) MJLH (*b*) LIKG
(*c*) MIKG (*d*) MNGM

15. ABC, ACE, ADG, ?
(*a*) AEG (*b*) AFH
(*c*) AFG (*d*) AEI

16. IOU, JKL, PQR, ?
(*a*) UVW (*b*) XYZ
(*c*) TUV (*d*) VWX

17. AZ, GT, MN, ?, YB
(*a*) KF (*b*) TS
(*c*) RX (*d*) SH

18. BMY, DNW, FOU, ?
(*a*) HPT (*b*) HPS
(*c*) HQS (*d*) GPS

19. ADG, GJM, MPS, ?
(*a*) SVW (*b*) SVY
(*c*) SUW (*d*) SWY

20. AZ, CX, EV, ?
(*a*) HU (*b*) GS
(*c*) GT (*d*) HT

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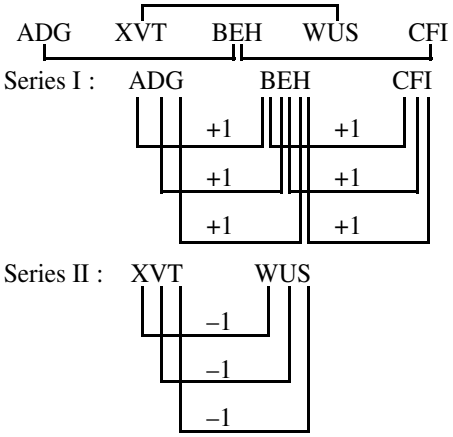
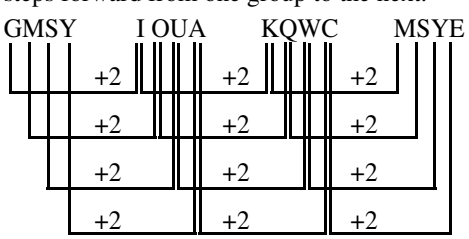
EXPLANATORY ANSWERS

1. (b) : There are two alternate series.

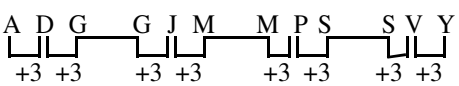


2. (a) : The series is formed by moving each letter two steps forward from one group to the next.

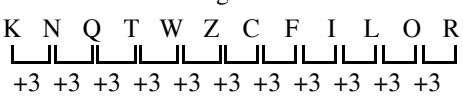


(The series restarts from A on reaching Z)

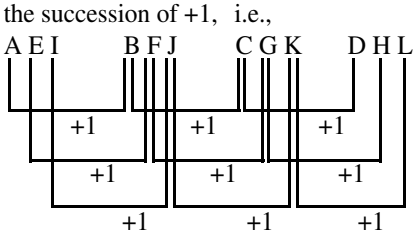
3. (a) : In each group of three letters the alphabet is in the succession of +3. The next group begins with the last alphabet of the previous group.



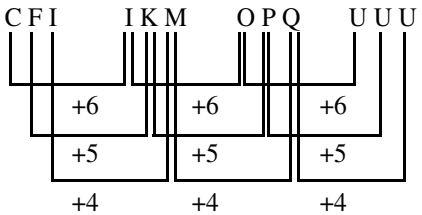
4. (b) : All the alphabet in this group series is in succession of +3. The alphabetical series repeat from 'A' on reaching 'Z'.



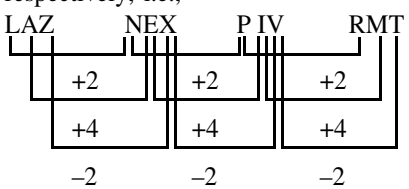
5. (d) : Each of the three alphabet in one group corresponds to the alphabet in the next group in the succession of +1, i.e.,



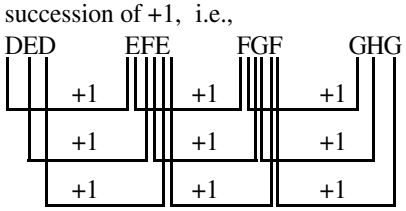
6. (a) : The three alphabet in one group correspond to the alphabet in the next group in the manner +6, +5, +4 respectively, i.e.,



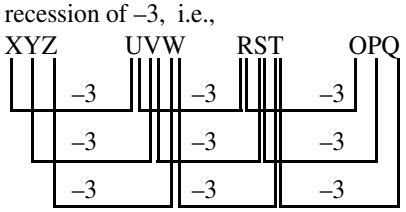
7. (c) : The three alphabet in one group correspond to the alphabet in the next group in the manner +2, +4, –2 respectively, i.e.,



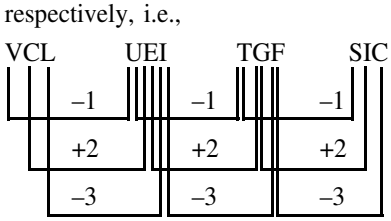
8. (b) : The alphabet from one group to the next are in succession of +1, i.e.,



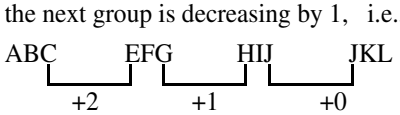
9. (a) : The alphabet from one group to the next are in recession of –3, i.e.,



10. (c) : The alphabet in one group correspond to the alphabet in the next group in the manner –1, +2, –3 respectively, i.e.,



11. (d) : The difference between the last letter of the preceding group of alphabet and the first letter of the next group is decreasing by 1, i.e.,



Otherwise the three letters in each group are in their natural order.

12. (d) : The letters in each group of alphabet are in the recession of –8, –4, –2 respectively.

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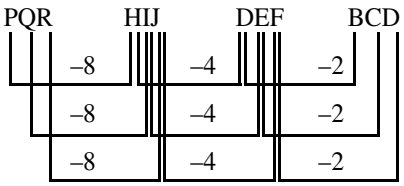
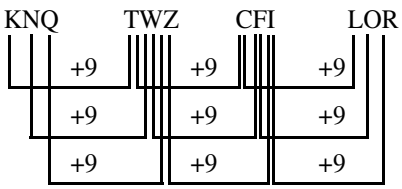
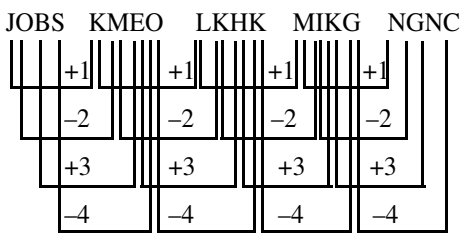


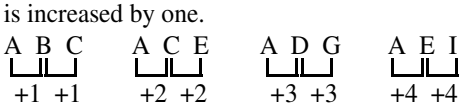
13. (b) : The letters in each group correspond to the letter in next group in the succession of +9.



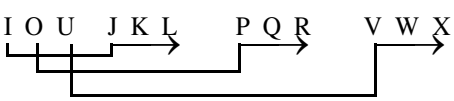
14. (c) : The alphabets in each group follow the pattern +1, –2, +3 and –4 respectively from one group to the next group.



15. (d) : The difference between the letters in each group is increased by one.

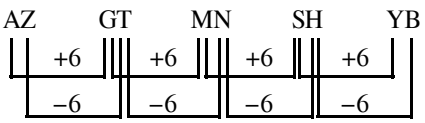


16. (d) : The series is formed in this manner :

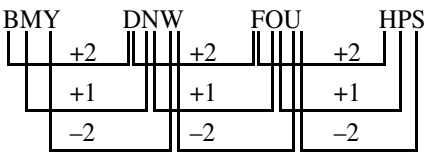


Three consecutive letters to each letter in the first group forms the other groups in the series.

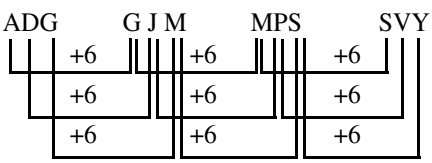
17. (d) : The letters in one group correspond to the letters in the next group in the manner +6, –6 respectively, i.e.,



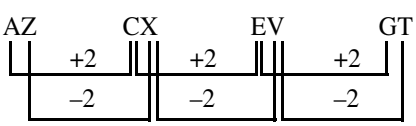
18. (b) : The letters in one group correspond to the letters in the next group in the manner +2, +1, -2 respectively, i.e.,



19. (b) : The letters in each group are moved six steps forward, i.e.,



20. (c) : The letters in each group correspond to the letters in the next group in the manner +2, –2 respectively, i.e.,



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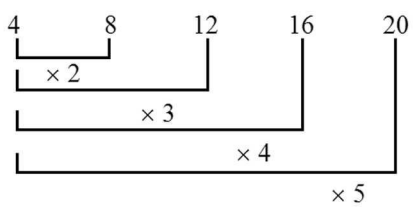
Number Series

In this type of series, the set of given numbers in a series are related to one another in a particular pattern or manner. The relationship between the numbers may be (i) consecutive odd/even numbers; (ii) consecutive prime numbers; (iii) squares/cubes of some numbers with/without variation of addition or subtraction of some number; (iv) sum/product/difference of preceding numbers; (v) addition/subtraction/multiplication/division by some number; and (vi) many more combinations of the relationships given above.

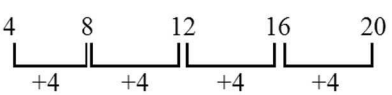
SOLVED EXAMPLES

1. Which number will complete the given series?
4, 8, 12, 16, ?
(*a*) 18 (*b*) 20 (*c*) 22 (*d*) 24

Ans. (*b*): The series is made of numbers which are multiples of 4. Other explanation can be that the difference between the two consecutive numbers is 4.

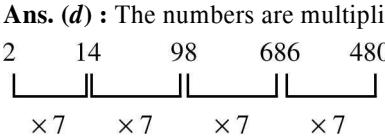


Or



2. Complete the given series.
2, 14, 98, 686, ?
(*a*) 1976 (*b*) 2548 (*c*) 980 (*d*) 4802

Ans. (*d*) : The numbers are multiplied by 7 to obtain the next numbers.



The given series may also comprise of two alternate series merged as one.

MULTIPLE CHOICE QUESTIONS

Directions: *In the following questions, select the number(s) from the given options for completing the given series.*

1. 3, 9, 27, 81, 243, ?
(*a*) 486 (*b*) 729
(*c*) 972 (*d*) 359

2. 1, 6, 12, 19, 27, ?
(*a*) 38 (*b*) 35
(*c*) 36 (*d*) 54

3. 2, 6, 14, 30, 62, ?
(*a*) 126 (*b*) 128
(*c*) 120 (*d*) 130

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4. 8, 48, 16, 96, 32, ?
(*a*) 192 (*b*) 150
(*c*) 64 (*d*) 288

5. 2, 8, 14, 24, 34, 48, ?
(*a*) 66 (*b*) 62
(*c*) 58 (*d*) 64

6. 4, 9, 19, 34, 54, ?, 109
(*a*) 89 (*b*) 84
(*c*) 74 (*d*) 79

7. 3, 15, 35, 63, 99, ?
(*a*) 144 (*b*) 143
(*c*) 121 (*d*) 169

8. 2, 3, 6, 18, 108, ?
(*a*) 1944 (*b*) 1658
(*c*) 648 (*d*) 1008

9. 1, 2, 3, 2, 3, 5, 4, 5, ?
(*a*) 9 (*b*) 6
(*c*) 10 (*d*) 7

10. 7776, 1296, 216, 36, 6, ?
(*a*) 6 (*b*) 0
(*c*) 3 (*d*) 1

11. 1, 8, 27, 64, 125, ?
(*a*) 172 (*b*) 176
(*c*) 216 (*d*) 189

12. 2, 3, 5, 7, 11, 13, ?
(*a*) 19 (*b*) 57
(*c*) 31 (*d*) 17

13. 80, 64, 48, 32, 16, ?
(*a*) 4 (*b*) 0
(*c*) 8 (*d*) 1

14. 3, 8, 13, 24, 41, ?
(*a*) 65 (*b*) 75
(*c*) 70 (*d*) 80

15. 9, 81, 90, 810, 819, ?
(*a*) 7371 (*b*) 900
(*c*) 8100 (*d*) 1638

16. 0, 8, 24, 48, 80, ?
(*a*) 110 (*b*) 96
(*c*) 120 (*d*) 140

17. 2, 4, 8, 3, 9, 27, 4, 16, ?
(*a*) 64 (*b*) 32
(*c*) 48 (*d*) 24

18. 27, 28, 25, 25, 23, 22, 21, ?
(*a*) 20 (*b*) 21
(*c*) 19 (*d*) 18

19. 80, 63, 72, 72, 64, 81, 56, ?
(*a*) 96 (*b*) 98
(*c*) 89 (*d*) 90

20. 0, 5, 22, 57, ?, 205
(*a*) 198 (*b*) 116
(*c*) 172 (*d*) 92

EXPLANATORY ANSWERS

1. (*b*) : The numbers in the series are multiplied by 3 to get the next numbers.

2. (*c*) : The difference between the numbers in the series increases by 1, after beginning from 5, *i.e.,*

1 6 12 19 27 36
+5 +6 +7 +8 +9

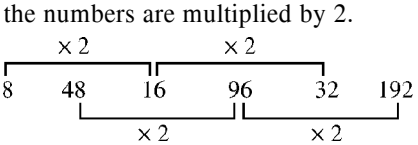
3. (*a*) : The difference between the numbers in the series doubles each time, after beginning from 4, *i.e.,*

2 6 14 30 62 126
+4 +8 +16 +32 +64

4. (*a*) : *Explanation I* : The sequence in the series is × 6, ÷ 3 which is repeated.

8 48 16 96 32 192
×6 ÷3 ×6 ÷3 ×6

Explanation II : There are two alternate series and the numbers are multiplied by 2.



Series I : 8, 16, 32
Series II : 48, 96, 192

5. (*b*) : The sequence in the series is :

2 8 14 24 34 48 62
+6 +6 +10 +10 +14 +14

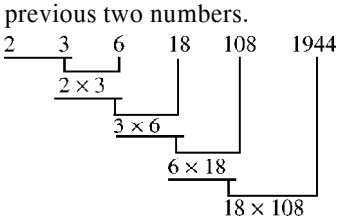
The difference increases by 4 at alternate step.

6. (*d*) : The difference between the numbers increases by 5, after beginning from 5, *i.e.,*

4 9 19 34 54 79 109
+5 +10 +15 +20 +25 +30

7. (*b*) : The series follows the sequence of the squares of even numbers beginning from 2, minus 1.

8. (*a*) : Every third number in the series is the product of previous two numbers.



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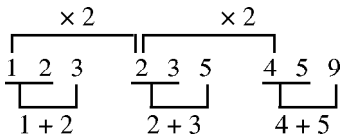
9. *(a)* : In this series three numbers form a set. The first two numbers of each set are in natural order and the third number is the sum of first and second numbers. The first number of the next set begins with double the first number of the previous set.



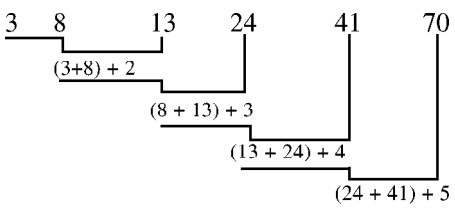
10. *(d)* : The numbers in this sequence are divided by 6 each time.

11. *(c)* : The sequence in the series is cube of numbers in their natural order.

12. *(d)* : The series consists of prime numbers in increasing order.

13. *(b)* : The numbers in the series are decreasing with the difference of 16 at each step.

14. *(c)* : The sequence in the series is (number + next number) + addition of natural number increasing by 1 at each step, after beginning from 2.



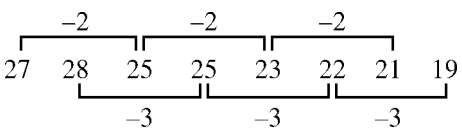
15. *(a)* : The sequence in the series is × 9, + 9 which is repeated.

16. *(c)* : The sequence of the series consists of the product of 2 even numbers in natural order, *i.e.,*

0	8	24	48	80	120
↓	↓	↓	↓	↓	↓
(0 × 2)	(2 × 4)	(4 × 6)	(6 × 8)	(8 × 10)	(10 × 12)

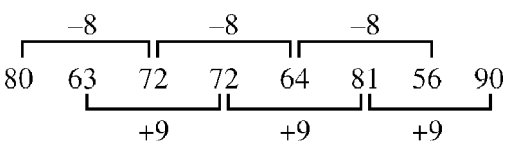
17. *(a)* : In this series 3 numbers form a set. The first number is in natural order. The second number is the square of above number. The third number is the cube of first number.

18. *(c)* : There are two alternate series :



Series I : 27, 25, 23, 21 (following –2 pattern)
Series II : 28, 25, 22, 19 (following –3 pattern)

19. *(d)* : There are two alternate series :



Series I : 80, 72, 64, 56 (following –8 pattern)
Series II : 63, 72, 81, 90 (following +9 pattern)

20. *(b)* : The series follows this sequence : cube of natural numbers starting from 1 minus odd numbers starting from 1.

0	5	22	57	116	205
↓	↓	↓	↓	↓	↓
1^3-1	2^3-3	3^3-5	4^3-7	5^3-9	6^3-11

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CHAPTER 6

Arithmatical Reasoning

MULTIPLE CHOICE QUESTIONS

Directions (1–5) : *The following questions are based on the information given below :*

Data of 450 candidates, who took part in an examination in Social Science, Mathematics and Science is given below:

Passed in all the subject	167
Failed in all the subject	60
Failed in Mathematics	199
Failed in Social Science	175
Failed in Science	191
Passed in Science only	52
Passed in Mathematics only	48
Passed in Social Science only	62

1. How many passed in at least one subject?
(*a*) 450 (*b*) 390
(*c*) 304 (*d*) 167
(*e*) None of these.

2. How many failed in two subjects only?
(*a*) 56 (*b*) 61
(*c*) 152 (*d*) 162
(*e*) None of these.

3. How many passed in Mathematics and at least in one more subject?
(*a*) 210 (*b*) 203
(*c*) 170 (*d*) 94
(*e*) None of these.

4. How many failed in Social Science only?
(*a*) 15 (*b*) 21
(*c*) 30 (*d*) 42
(*e*) None of these.

5. How many failed in one subject only?
(*a*) 152 (*b*) 144
(*c*) 61 (*d*) 56
(*e*) None of these

6. A, B, C, D and E play a game of cards. A says to B, ''If you give me three cards, you will have as many as E has and if I give you three cards, you will have as many as D has.'' A and B together have 10 cards more than what D and E together have. If B has two cards more than what C has and the total number of cards be 133, how many cards does B have?
(*a*) 22 (*b*) 35
(*c*) 25 (*d*) 23
(*e*) None of these

7. A bus starts from city X. The number of women in the bus is half of the number of men. In the city Y, 10 men left the bus and five women entered. Now, number of men and women is equal. In the beginning, how many passenger entered the bus?
(*a*) 15 (*b*) 30
(*c*) 36 (*d*) 45
(*e*) None of these

8. I have a few sweets to be distributed. If I keep 2, 3 or 4 in a pack, I am left with one sweet. If I keep 5 in a pack, I am left with none. What is the minimum number of sweets I can have to pack and distributed?
(*a*) 25 (*b*) 37
(*c*) 54 (*d*) 65
(*e*) None of these

9. A, B, C, D and E play a game of cards. A says to B, ''If you give me 3 cards, you will have as many as I have at this moment while if D takes 5 cards from you, he will have as many as E has'', A and C together have twice as many cards as E has B and D together also have the same number of cards as A and C taken together. I all together they have 150 cards, how many cards has C got.
(*a*) 28 (*b*) 29
(*c*) 31 (*d*) 35
(*e*) None of these

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10. At the end of a business conference, ten people present shake hands with each other once. How many handshakes will be there all together?
(*a*) 20 (*b*) 45
(*c*) 90 (*d*) 55
(*e*) None of these.

11. Jayesh is as much younger to Anil as he is older to Prashant. If the sum of the ages of Anil and Prashant is 48 years. What is the age of Jayesh?
(*a*) 30 years
(*b*) 24 years
(*c*) 20 years
(*d*) Can't be determined
(*e*) None of these.

12. Five years ago Vinay's age was one-third of the age of Vikash and now Vinay's age is 17 years. What is the present age of Vikash?
(*a*) 9 years (*b*) 36 years
(*c*) 41 years (*d*) 51 years

13. The sum of ages of a father and son is 45 years. Five years ago the product of their ages was 4 times the father's age at that time. The present age of the father and son respectively are.
(*a*) 25 years, 10 years (*b*) 36 years, 9 years
(*c*) 39 years, 6 years (*d*) None of these.

14. Out of a total 120 musicians in a club, 5% can play all the three instruments – guitar, violin and flute. It so happens that the number of musicians who can play any two and only two of the above instruments is 30. The number of musicians who can play the guitar alone is 40. What is the total number of those who can play violin alone or flute alone?
(*a*) 30 (*b*) 38
(*c*) 44 (*d*) 45
(*e*) None of these.

15. In a group of persons travelling in a bus, 6 persons can speak Tamil, 15 can speak Hindi and 6 can speak Gujarati. In that group, none can speak any other language. If 2 persons in the group can speak two languages and one person can speak all the three languages, then how many persons are there in the group?
(*a*) 21 (*b*) 22
(*c*) 23 (*d*) 24
(*e*) None of these.

16. There are 50 students admitted to a nursery class. Some students can speak only English and some can speak only Hindi. Ten students can speak both English and Hindi. If the number of students who can speak English is 21, then how many students can speak Hindi, how many can speak only Hindi and how many can speak only English?
(*a*) 39, 29 and 11 respectively.
(*b*) 37, 27 and 13 respectively.
(*c*) 28, 18 and 22 respectively.
(*d*) 21, 11 and 29 respectively.

17. A shephard had 17 sheep. All but nine died. How many was he left with?
(*a*) Nil (*b*) 17
(*c*) 9 (*d*) 8
(*e*) None of these.

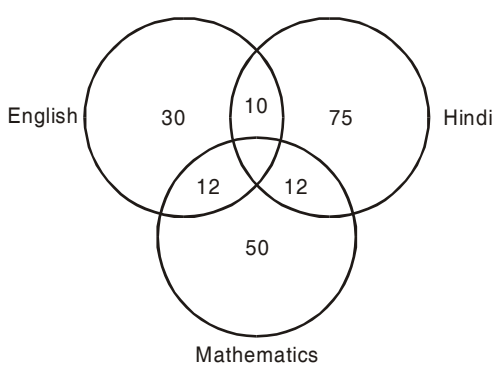
18. 10 years ago, Chandravati's mother was 4 times older than her daughter. After 10 years, the mother will be twice older than the daughter. The present age of Chandravati is:
(*a*) 5 years (*b*) 10 years
(*c*) 20 years (*d*) 30 years
(*e*) None of these.

19. Pushpa is twice as old as Rita was two years ago. If difference between their ages be 2 years, how old is Pushpa today?
(*a*) 6 years (*b*) 8 years
(*c*) 10 years (*d*) 12 years

20. Mr. Sohan Lal is four times as old as his son. Four years later sum of their age will be 43 years. The present age of the son is:
(*a*) 5 years (*b*) 7 years
(*c*) 8 years (*d*) 10 years
(*e*) None of these.

21. 15 years ago the difference between the age of two persons is 10 years. The elder one was twice as old as the younger one. The present age of the elder person is:
(*a*) 15 years (*b*) 35 years
(*c*) 65 years (*d*) 45 years
(*e*) None of these.

22. Consider the diagram given below:



Five hundred candidates appeared in the examination conducted for the tests in English, Hindi and Mathematics. The diagram gives the number of candidates who failed in different tests. What is the percentage of candidates who failed in at least two subjects?

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(*a*) 0.078 (*b*) 1.0
(*c*) 6.8 (*d*) 7.8
(*e*) None of these.

23. The sum of the ages of a son and father is 56 years. After four years, the age of the father will be three times that of the son. Their ages respectively are:
(*a*) 12 years, 44 years (*b*) 18 years, 36 years
(*c*) 16 years, 42 years (*d*) 16 years, 48 years
(*e*) None of these.

24. The number of boys in a class are three times the number of girls. Which one of the following numbers cannot represent the total number of children in the class?
(*a*) 48 (*b*) 44
(*c*) 42 (*d*) 46
(*e*) None of these.

25. In 10 years, A will be twice as old as B was 10 years ago. If at present A is 9 years older than B, the present age of B is:
(*a*) 19 years (*b*) 29 years
(*c*) 39 years (*d*) 49 years
(*e*) None of these.

EXPLANATORY ANSWERS

1. (*b*) : Candidates passed at least in one subject = (Candidates passed in only one subjects) + (Candidates passed in only two subjects) + (Candidates passed in only all subjects).
(Candidates failed in only two subjects) + (Candidates failed in only one subject) + (Candidates passed in all the subject)
= 162 + 61 + 167 = 390.

2. (*d*) : Candidates failed in two subjects only = Candidates passed in one subjects only = 62 + 48 + 52 = 162.

3. (*b*) : Candidates failed in science only =191 – (62 + 60 + 48) = 21
Candidates failed in one social science only = 15
Therefore, candidates passed in maths and at least one more subject
= (21 + 15 + 167) =203

4. (*a*) : Candidates failed in social science only = (candidates failed in social science) – (candidates failed in all subjects + candidates passed in science only + candidates passed in maths only)
= 175 – (60 + 52 + 48) = 175 – 160 = 15.

5. (*c*) : Candidates failed in one subject only
= (total number of candidates) – (candidates passed in all subjects + candidates failed in all the subjects + candidates passed in one subject only)
= 450 – (167 + 60 + 62 + 48 + 52)
= 450 – 389 = 61.

6. (*c*) : From the questions, we have
B – 3 = E ..... (i)
B + 3 = D ..... (ii)
A + B = D + E + 10 ..... (iii)
B = C + 2 ..... (iv)
A + B + C + D + E = 133 ..... (v)
From (i) and (ii)
B – E = D – B $\Rightarrow$ E + D = 2 B ..... (vi)
From (iii) and (vi)
A + B = 2B + 10 $\Rightarrow$ B = A – 10
or, A = B + 10 ..... (vii)
From (v), (vi), (iv) and (vii) we have
(B + 10) + (B) + (B – 2) + 2B = 133
5B = 133 – 8 = 125
= 25.

7. (*d*) : In the city X let the number of men be x
Then the number of women be $\frac{x}{2}$.
In the city y, $x-10=\frac{x}{2}+5$
or, $\frac{x}{2}=15$ or, $x=30$ and $y=15$.
Therefore, total number of passenger at the beginning were 30 + 15 = 45.

8. (*a*) : The required number will be obtained by taking LCM of 2, 3 and 4 and adding 1 into it. The number so obtained is 25.

9. (*a*) : From the questions it is clear that
B – 3 = A ..... (1)
D + 5 = E ..... (2)
A + C = 2 E ..... (3)
A + C = B + D ..... (4)
A + B + C + D + E = 150 ..... (5)
From (3), (4) and (5) we get
5E = 150 $\therefore$ E = 30
Now from (2) D = 30 – 5 = 25
and from (4) A = 32
Now from (3) 32 + C = 2 × 30
C = 60 – 32 = 28.

10. (*b*) : Total number of handshakes = (9 + 8 + 7 + 6 + 5 + 4 + 3 + 2 + 1) = 45

11. (*b*) : Let the age of Anil and Prashant be x and (48 – x) years.
Let the age of Jayesh be y years then
(x – y) = y – (48 – x)
x – y = y – 48 + x
2y = 48, y = 24 years
So, Age of Jayesh is 24 years.

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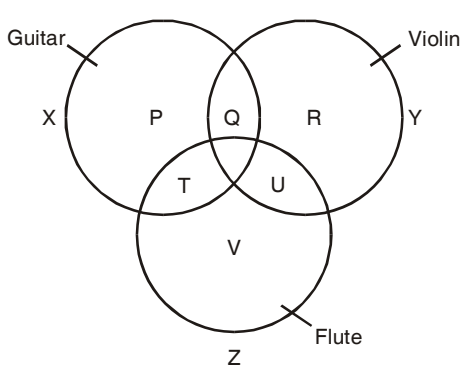
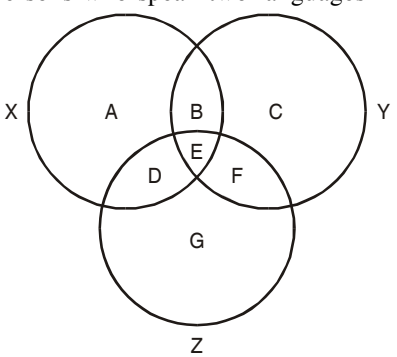
12. (*c*) : Vinay's present age is 17 years.
Five years ago Vinay's age was 12 years. and that of Vikash = 36 years
Present age of Vikash = 36 + 5 = 41 years.

13. (*b*) : Let the present age of father be x years and that of son be $(45 - x)$ years.
Five years ago the age of son was $(45 - x - 5) = (40 - x)$.
and that of father $(x - 5)$ years
$(x - 5)(40 - x) = 4(x - 5)$
$40x - x^2 - 200 + 5x = 4x - 20$
or, $41x - x^2 - 180 = 0$
$x = 36$.
$x^2 - 41x - 180 = 0$
$x^2 - (36 + 5)x + 180 = 0$
or, $x^2 - 36x - 5x + 180 = 0$
$x(x - 36) - 5(x - 36) = 0$
$(x - 36)(x - 5) = 0$
$x = 36 \mid x = 5$ unacceptable
Therefore, the present age of father and son are 36 years and 9 years respectively.

14. (*c*) : Let the circles x, y, z represent the musicians who can play guitar, violin and flute respectively.
P + Q + R + S + T + U + V = 120 ..... (1)
Number of musicians who can play all the three instruments = S = 5% of 120 = 6
S = 6 ..... (2)
Number of musicians who can play guitar only = P = 40 ..... (3)
Number of musicians who can play any two and only two of the instruments
= Q + T + U = 30 ..... (4)
Now, from equations (1), (2), (3) and (4) we get
P + Q + R + S + T + U + V = 120
P + (Q + T + U) + S + R + V = 120
40 + 30 + 6 + R + V = 120
R + V = 120 – 76
= 44
Total number of musicians who can play violin alone or flute alone
= (R + V)
= 44

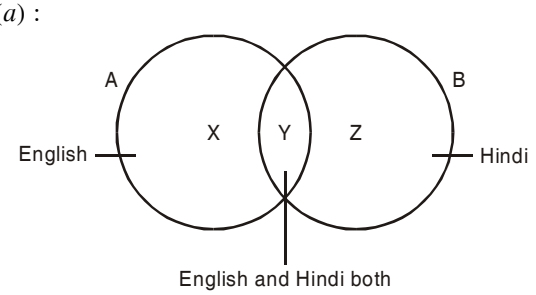


15. (*c*) : Let circles x, y and z represent persons who can speak Tamil, Hindi and Gujarati respectively.
Persons who speak Tamil
= A + B + D + E = 6 ... (1)
Persons who speak Hindi
= B + C + E + F = 15 ... (2)
Persons who speak Gujarati
= D + E + F + G = 6 ... (3)
Persons who speak two languages



= B + D + F = 2 ... (4)
Persons who speak all the three language
= E = 1 ... (5)
Substituting the value of E in equations (1), (2) and (3) we get
A + B + D = 5 ... (6)
B + C + F = 14 ... (7)
D + F + G = 5 ... (8)
Subtracting (4) from (6), we get
A – F = 3 ... (9)
Adding (7) and (8) we get
B + C + 2F + D + G = 19 ... (10)
Adding (9) and (10) we get
A + B + C + D + F + G = 22 ... (11)
Adding (5) and (11) we get
A + B + C + D + E + F + G = 23 ... (12)
Therefore, total number of person = 23.

16. (*a*) :



Circle A and B represent the students who speak English and Hindi respectively. Now as per information given in the question total number of students
$= x + y + z = 50$ ... (1)
$y = 10$ ... (2)
$x + y = 21$ ... (3)
From (2) and (3) $x = 11$
Number of students who can speak Hindi is $(y + z)$

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From (1) we get

$y + z = 50 - 11 = 39$ ... (4)

Now, number of students who can speak Hindi only is z.

From (4), $y + z = 39$, $z = 39 - y = 39 - 10 = 29$

Therefore, number of the students speaking Hindi = 39, number of students speaking Hindi only = 29 and number of students speaking English only = 11.

17. (*c*) : 'All but nine died' means 'All except nine died'. It means that nine sheep remained alive and other died.

18. (*c*) : Let Chandravati's age 10 years ago be x year mother's age 10 yeags ago was $4x$ year.

After ten year, or after 20 years when Chandravati's age was 10 years.

$(4x + 20) = 2(x + 20)$

$4x + 20 = 2x + 40$

$2x = 20$

or, $x = 10$ years

Present age of Chandravati = 20 years.

19. (*b*) : Let the present age of Pushpa be x year. The present age of Rita would be $(x - 2)$ year.

Now as per question, $x = 2(x - 2 - 2)$

or, $x = 2x - 8$

or, $x = 8$

Therefore, present age of Pushpa is 8 years.

20. (*b*) : Let the present age of the son be x years then, the age of Sohanlal would be $4x$ years. Four years later their age would be $(x + 4)$ and $(4x + 4)$ years.

Now, as per questions,

$(x + 4) + (4x + 4) = 43$ years

$5x + 8 = 43$ years

$5x = 35$ years

or, $x = 7$ years.

Therefore, the present age of son is 7 years.

21. (*b*) : Let the present age of the elder persons be x years.

then, the present age of the younger person

$= (x - 10)$ years.

$(x - 15) = 2(x - 10 - 15)$

or, $x = 35$ years.

$\therefore$ The present age of the elder person is 35 years.

22. (*d*) : From the diagram it is clear that number of candidates who failed in at least two subjects = number of candidates who failed in two or more subjects.

$= (10 + 12 + 12 + 5) = 39$

Therefore, required percentage

$$\left(\frac{39}{500} \times 100\right)\% = 7.8\%$$

Therefore, option (*d*) is our answer.

23. (*a*) : Let the age of the father be x, then the age of the son would be $(56 - x)$.

After four years, the age of father would be $(x + 4)$ and that of son would be $(56 - x + 4)$

Now from the information given in the questions.

We have

$(x + 4) = 3(56 - x + 4)$

$x + 4 = 168 - 3x + 12$

$4x = 168 + 12 - 4 = 176$

$x = 44$ years

Therefore, the age of father and son is 44 years and 12 years respectively.

24. (*c*) : Let the number of girls be x, then from the question it is clear that number of boys are $3x$.

Therefore, total number of students

= Number of Boys + Numbers of girls

$= x + 3x = 4x$.

Now, the total number of children in the class must be a multiple of 4.

Out of the four options (c) does not qualify this condition. Hence 42 does not represent the total number of children in the class.

25. (*c*) : Let the present age of B be x years

The present age of A would be $(x + 9)$ years.

After ten years the age of A would be $(x + 9 + 10) = (x + 19)$ years. and before ten years the age of B was $(x - 10)$ years.

Now from the information given in the question,

$(x + 19) = 2(x - 10)$

$x + 19 = 2x - 20$

$x = 19 + 20 = 39$ years.

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Problem Solving

Number problems consists of number sequences, problems with algebraic expressions, mathematical calculations and other compatiable problems.

SOLVED EXAMPLES

1. How many such 7s are there in the following number sequence which are immediately followed by 4 but not immediately preceded by 8?

5 4 7 8 9 7 4 3 8 7 5 7 4 8 7 4 1 2 7 4 5 7 9 4

(a) Two (b) Three (c) Four (d) Five (e) None of these

Ans. (b) : Number of 7s which are immediately followed by 4 but not immediately preceded by 8 are :

5 4 7 8 9 7 4 3 8 7 5 7 4 8 7 4 1 2 7 4 5 7 9 4

1 2 3

2. A number is 9 times twice the other number. The sum of two numbers is 133. The two numbers are :

(a) 9, 124 (b) 11, 122 (c) 17, 166 (d) 7, 126 (e) 27, 136

Ans. (d) : If the smaller number is x, then

$$x + (2x \times 9) = 133$$
$$x + 18x = 133$$
$$19x = 133$$
$$x = 133 \div 19 = 7$$

If one number is 7, the other number is :

$$133 - 7 = 126$$

3. If all the numbers from 1 to 28 which are exactly divisible by 3 are arranged in descending order, which would come at the sixth place from the top?

(a) 12 (b) 21 (c) 15 (d) 18 (e) 24

Ans. (a) : The numbers divisible by 3 in descending order are : 27, 24, 21, 18, 15, 12, 9, 6, 3 and the number at the sixth place is 12.

MULTIPLE CHOICE QUESTIONS

1. How many 6's are there in the following series of numbers which are preceded by 7 but not immediately followed by 9?

6 7 9 5 6 9 7 6 8 7 6 7 8 6 9 4 6 7 7 6 9 5 7 6 3

(a) One (b) Two

(c) Three (d) Four

2. In a chess tournament each of six players will play every other player exactly once. How many matches will be played during the tournament?

(a) 12 (b) 15

(c) 30 (d) 36

3. How many 4's are there in the following series which are preceded by 7, but are not preceded by 8?

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3 4 5 7 4 3 7 4 8 5 4 3 7 4 9 8 4 7 2 7 4 1 3 6
(a) 1 (b) 2
(c) 3 (d) 4

4. How many even numbers are there in the following series of numbers, each of which is immediately preceded by an odd number, but not immediately followed by an even number?

5 3 4 8 9 7 1 6 5 3 2 9 8 4 3 5
(a) Nil (b) 1
(c) 2 (d) 3

5. If all the numbers from 1 to 51 which are exactly divisible by 3 are arranged in descending order, which of the following numbers will come at the seventh and tenth places from the top?
(a) 33 & 27 (b) 33 & 21
(c) 21 & 30 (d) 33 & 24

6. Nitin was counting down from 32. Shasank was counting upwards, the numbers starting from 1 and he was calling out only the odd numbers. Which common number will they call out at the same time if they were calling out at the same speed?
(a) 21
(b) 22
(c) 19
(d) They will not call out the same number

7. In the following list of numerals, how many 3s are followed by 3, but NOT preceded by 3?

2 4 6 3 3 1 5 7 8 3 3 3 4 6 2 3 3 3 3 9 7 2 3
(a) 1 (b) 2
(c) 3 (d) 4

8. If in a given number 5 8 9 4 3 2 7 6 1 4, we interchange the first and the second digits, the third and the fourth, the fifth and the sixth and so on, then counting from the right end, which digit will be sixth?
(a) 3 (b) 2
(c) 4 (d) 5

9. Aparna cuts a cake into two halves and cuts one-half into smaller pieces of equal size. Each of the small pieces is twenty grams in weight. If she has seven pieces of the cake in all with her, how heavy was the original cake?
(a) 140 grams (b) 280 grams
(c) 240 grams (d) 120 grams

10. In the following number sequence how many such even numbers are there which are exactly divisible by its immediate preceding number but not exactly divisible by its immediate following number?

3 8 4 1 5 7 2 8 3 4 8 9 3 9 4 2 1 5 8 2
(a) Two (b) Three
(c) Four (d) More than four

11. How many 7s are there in the following series which are not immediately followed by 3 but immediately preceded by 8?

8 9 8 7 6 2 2 6 3 2 6 9 7 3 2 8 7 2 7 7 8
7 3 7 7 9 4
(a) Nil (b) One
(c) Two (d) Three

12. How many 9's are there in the following sequence which are neither preceded by 6 nor immediately followed by 3?

9 3 8 6 9 9 5 9 3 7 8 9 9 9 3 9 6 3 9
(a) One (b) Two
(c) Three (d) Four

13. If a number is five times as great as another number which is four less than forty, then the number is :
(a) 220 (b) 180
(c) 144 (d) 200

14. If 2/3rd of a number is 96, what will be the 3/4th of that number?
(a) 108 (b) 198
(c) 128 (d) 48

15. If such numbers which are divisible by 5, and also those which have 5 as one of the digits are eliminated from the numbers 1 to 60, how many numbers would remain?
(a) 53 (b) 47
(c) 40 (d) 45

16. How many 8's are there in the following number series which are exactly divisible by its immediately preceding and also exactly divisible by immediately succeeding numbers?

8 2 4 5 1 7 2 8 4 8 4 2 2 8 2 6 9 8 4 5 4 8
3 2 8 4 3 1 8 3
(a) 1 (b) 2
(c) 3 (d) 4

17. Jagan was to either get one-seventh of a milk chocolate or one-fourteenth of a bigger fruit chocolate. Which chocolate would give him the larger piece if the fruit chocolate is three times as large as the milk chocolate?
(a) Milk chocolate
(b) Fruit chocolate
(c) The pieces will be of the same size
(d) Information inadequate

18. How many such 3's are there in the following number sequence which are immediately preceded by an odd number and immediately followed by an even number?

5 3 8 9 4 3 7 2 3 8 1 3 8 4 2 3 5 7 3 4 2 3 6
(a) One (b) Two
(c) Three (d) Four

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19. Count each 7 which is not immediately preceded by 5 but is immediately followed by either 2 or 3. How many such 7's are there?

5 7 2 6 5 7 3 8 3 7 3 2 5 7 2 7 3 4 8 2 6 7 8

(a) 2 (b) 3
(c) 4 (d) 5

20. A number is four less than two times the other number. If their difference is 21, what is the greater number?

(a) 50 (b) 46
(c) 31 (d) 21

EXPLANATORY ANSWERS

1. (c) : 6 7 9 5 6 9 7 6 8 7 6 7 8 6 9 4 6 7 7 6 9 5 7 6 3

2. (b) : When all the players have to play with each other then the method of calculating the number of matches to be played is $\frac{n(n-1)}{2}$ where 'n' is the number of players playing the match. So, the number of matches played will be :
$(6 \times 5) \div 2 = 30 \div 2 = 15$

3. (*d*) : 3 4 5 7 4 3 7 4 8 5 4 3 7 4 9 8 4 7 2 7 4 1 3 6

4. (c) : 5 3 4 8 9 7 1 6 5 3 2 9 8 4 3 5

5. (*d*) : The numbers divisible by 3 in descending order are:
51, 48, 45, 42, 39, 36, 33, 30, 27, 24, 21, 18, 15, 12, 9, 6, 3.

6. (d) : When Nitin is on count 22, Shasank is on 21 and when Nitin is on count 21, Shasank is on 23.

7. (c) : 2 4 6 3 3 1 5 7 8 3 3 3 4 6 2 3 3 3 3 9 7 2 3

8. (b) : The new number after interchanging the digits is :
8 5 4 9 2 3 6 7 4 1
6th

9. (c) : There is one bigger piece and six smaller pieces. One small piece weighs 20 gm. Total weight of six smaller speices is 120 gm.
$\therefore$ Weight of the bigger piece = 120 gm
$\therefore$ Weight of the original cake = 240 gm

10. (a) : 3 8 4 1 5 7 2 8 3 4 8 9 3 9 4 2 1 5 8 2

11. (*c*) : 89876226326973287277873794

12. (d) : 9 3 8 6 9 9 5 9 3 7 8 9 9 9 3 9 6 3 9

13. (b) : Number four less than forty is $40 - 4 = 36$
Five times the number is $= 36 \times 5 = 180$

14. (a) : If the number is x, then

$$\frac{2}{3}x = 96$$

$$x = \frac{96 \times 3}{2} = 144$$

$\frac{3}{4}$ th of the number is $144 \times \frac{3}{4} = 108$

15. (c) : The eliminated twenty numbers are : 5, 10, 15, 20, 25, 30, 35, 40, 45 and 50 to 60. The remaining numbers are $60 - 20 = 40$.

16. (d) : 8 2 4 5 1 7 2 8 4 8 4 2 2 8 2 6 9 8 4 5 4 8
3 2 8 4 3 1 8 3

17. (b) : If fruit chocolate (F) is equal to three times as milk chocolate (M) then —

$$F = 3M$$

or $$\frac{F}{M} = 3$$

$$\therefore \quad \frac{1/14\ F}{1/7\ M} = \frac{3/14}{1/7}$$

When 3/14 > 1/7, then F (Fruit chocolate) will give him the larger piece.

18. (c) : 5 3 8 9 4 3 7 2 3 8 1 3 8 4 2 3 5 7 3 4 2 3 6

19. (a) : 5 7 2 6 5 7 3 8 3 7 3 2 5 7 2 7 3 4 8 2 6 7 8

20. (b) : If smaller number is x, then

$$(2x - 4) - x = 21$$
$$2x - x = 21 + 4$$
$$x = 25$$

The greater number is
$(25 \times 2) - 4 = 46$

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CHAPTER 8

Numerical Operations/ Symbol Substitution

Questions in this category are easy to attempt. Candidates must be quick in substituting symbols and calculations. The common pattern of questions asked are given below.

SOLVED EXAMPLES

1. If '+' stands for '×'; '×' stands for '÷'; '÷' stands for '–' and '–' stands for '+' then
$2 - 8 \times 2 + 6 \div 7 = ?$
(*a*) 32 (*b*) 19 (*c*) 23 (*d*) 9
Ans. (***b***) **:** After substituting the symbols in the given expression the new expression will be :
$2 + 8 \div 2 \times 6 - 7$
The solving steps will be :
$2 + 4 \times 6 - 7$
$2 + 24 - 7$
$26 - 7 = 19$

2. If ▲ stands for '+'
■ stands for '–'
● stands for '÷'
❋ stands for '×' then
$13 \quad ▲ 5 ❋ 20 ● 10 ■ 9 = ?$
(*a*) 26 (*b*) 37 (*c*) 14 (*d*) 55
Ans. (***c***) **:** After substituting the symbols the new expression will be :
$13 + 5 \times 20 \div 10 - 9$
The solving steps will be :
$13 + 5 \times 2 - 9$
$13 + 10 - 9$
$23 - 9 = 14$

MULTIPLE CHOICE QUESTIONS

Directions : *Each of the following questions is followed by four alternatives. Select the most appropriate answer.*

1. If "+" means "–"; "–" means "×"; "×"means "÷" and "÷" means "+", then
$15 \times 5 \div 10 + 5 - 3 = ?$
(*a*) 9.5 (*b*) 0
(*c*) – 2 (*d*) 24

2. If "+" means "–"; "–" means "×"; "×"means "÷" and "÷" means "+", then
$15 \times 3 \div 15 + 5 - 2 = ?$
(*a*) 0 (*b*) 10
(*c*) 20 (*d*) 6

3. If "+" means "÷"; "×" means "–"; "÷"means "+" and "–" means "×", then
$16 \div 8 \times 6 - 2 + 12 = ?$
(*a*) 22 (*b*) 24
(*c*) 23 (*d*) 20

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4. If "+" means "×"; "–" means "÷"; "÷"means "+" and "×" means "–", then what will be the value of $20 \div 40 - 4 \times 5 + 6 = ?$
(*a*) 60 (*b*) 1.67
(*c*) 150 (*d*) 0

5. If "+" means "×"; "–" means "÷"; "×"means "–" and "÷" means "+", then
$5 + 8 - 4 \times 2 \div 9 = ?$
(*a*) 15 (*b*) 13
(*c*) 17 (*d*) 11

6. If × stand for addition, ÷ stands for subtraction, + stands for multiplication and – stands for division, then $(20 \times 6 \div 6 \times 4)$ is equal to
(*a*) 5 (*b*) 24
(*c*) 25 (*d*) 80

7. If "+" means "×"; "÷" means "–"; "×"means "÷" and "–" means "+", what will be the value of the following expression?
$4 + 11 \div 5 - 50 = ?$
(*a*) 79 (*b*) –11
(*c*) 91 (*d*) 89

8. If "+" means "÷"; "÷" means "–"; "–"means "×" and "×" means "+", then
$10 \div 2 - 15 + 3 \times 5 = ?$
(*a*) 10 (*b*) 15
(*c*) 25 (*d*) 5

9. If A stands for add, B for subtract, C for multiply and D for divide, then for what does 4A 3B 3A 2 stand?
(*a*) 2 (*b*) 4
(*c*) 6 (*d*) 8

10. If × stands for add, *y* stands for subract, *z* stands for divide and *p* stands for multiply, then what is the the value of (7 p 3) y 6 × 5?
(*a*) 5 (*b*) 10
(*c*) 15 (*d*) 20

11. If "+" means "÷"; "÷" means "–"; "–"means "×" and "×" means "+", what will be the value of $8 + 2 \div 3 - 4 \times 6 = ?$
(*a*) –2 (*b*) $-15\frac{1}{3}$
(*c*) 12 (*d*) 15

12. If "+" means "÷"; "×" means "–"; "÷"means "×" and "–" means "+", what will be the value of the following expression?
$9 + 3 \div 4 - 8 \times 2 = ?$
(*a*) $6\frac{3}{4}$ (*b*) $-1\frac{3}{4}$
(*c*) $-6\frac{1}{4}$ (*d*) 18

13. If "–" means "÷"; "+" means "×"; "÷"means "–" and "×" means "+", then which of the following must be true?
(*a*) $1 \div 2 + 3 \times 6 - 8 = 12$
(*b*) $2 + 3 - 5 \times 8 \div 4 = 7$
(*c*) $5 + 6 \times 8 - 2 \div 3 = 31$
(*d*) $6 \div 1 + 2 - 8 \times 4 = 31$

14. If "÷" means "+"; "+" means "×"; "–"means "÷" and "×" means "–", then
$5 + 8 - 4 \times 2 \div 9 = ?$
(*a*) 13 (*b*) 15
(*c*) 11 (*d*) 17

EXPLANATORY ANSWERS

1. (*c*) : $15 \div 5 + 10 - 5 \times 3$
$3 + 10 - 15 = -2$

2. (*b*) : $15 \div 3 + 15 - 5 \times 2$
$5 + 15 - 10 = 10$

3. (*c*) : $16 + 8 - 6 \times 2 \div 12$
$16 + 8 - 1 = 23$

4. (*d*) : $20 + 40 \div 4 - 5 \times 6$
$20 + 10 - 30 = 0$

5. (*c*) : $5 \times 8 \div 4 - 2 + 9$
$10 - 2 + 9 = 17$

6. (*b*) : $20 + 6 - 6 + 4 = 24$

7. (*d*) : $4 \times 11 - 5 + 50$
$44 - 5 + 50 = 89$

8. (*d*) : $10 - 2 \times 15 \div 3 + 5$
$10 - 10 + 5 = 5$

9. (*c*) : $4 + 3 - 3 + 2 = 6$

10. (*d*) : $(7 \times 3) - 6 + 5$
$21 - 6 + 5 = 20$

11. (*a*) : $8 \div 2 - 3 \times 4 + 6$
$4 - 12 + 6 = -2$

12. (*d*) : $9 \div 3 \times 4 + 8 - 2$
$12 + 8 - 2 = 18$

13. (*c*) : (*a*) $1 - 2 \times 3 + 6 \div 8 = 12 \Rightarrow \frac{-17}{4} = 12$

(*b*) $2 \times 3 \div 5 + 8 - 4 = 7 \Rightarrow \frac{26}{5} = 7$

(*c*) $5 \times 6 + 8 \div 2 - 3 = 31 \Rightarrow 31 = 31$

(*d*) $6 - 1 \times 2 \div 8 + 4 = 31 \Rightarrow \frac{-39}{4} = 31$

14. (*d*) : $5 \times 8 \div 4 - 2 + 9$
$10 - 2 + 9 = 17$

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CHAPTER 9

Word Building

These are spellings, word order and dictionary related questions. The candidate is given a word and asked to select the word that can/cannot be formed from its spellings. He/she may be asked to decide the meaningful order of the given words. He/she may also be asked to arrange the given words in the sequence in which they occur in the dictionary.

MULTIPLE CHOICE QUESTIONS

Directions (Qs. No. 1 to 12): *From the given alternatives select the word which* ***cannot*** *be formed using the letters of the given word.*

1. REPUBLICAN
(*a*) CLIP (*b*) PURE
(*c*) ANKLE (*d*) BANE

2. ESTRANGE
(*a*) GENERATE (*b*) SERGEANT
(*c*) REAGENTS (*d*) GREAT

3. DETERMINATION
(*a*) DETENTION (*b*) DESTINATION
(*c*) TERMINATE (*d*) DOMINATE

4. CHRISTMAS
(*a*) CHRIST (*b*) SMART
(*c*) CRUST (*d*) HARM

5. LEGALIZATION
(*a*) ALERT (*b*) ALEGATION
(*c*) GALLANT (*d*) NATAL

6. CHARACTER
(*a*) CRATE (*b*) CHARTER
(*c*) HEARTY (*d*) TRACER

7. ADMINISTRATION
(*a*) Station (*b*) Minister
(*c*) Ration (*d*) Mind

8. ORGANISATION
(*a*) ORGAN (*b*) ORGANISE
(*c*) NATION (*d*) ORATION

9. PERAMBULATOR
(*a*) RAMPANT
(*b*) LABOUR
(*c*) MARBLE
(*d*) RAMBLE

10. POSSESSION
(*a*) SESSION
(*b*) POSE
(*c*) POISE
(*d*) OBSESS

11. PRINTINGS
(*a*) SAINT (*b*) PRINT
(*c*) STING (*d*) RINGS

12. QUALIFICATION
(*a*) LIAR (*b*) FIAT
(*c*) LION (*d*) FICTION

13. From the given alternatives select the word which can be formed using the letters given in the word.
ULTRANATIONALISM
(*a*) ULTRAMONTANE
(*b*) ULTRAMODERN
(*c*) ULTRAIST
(*d*) ULULATE

14. A meaningful word starting with R is made from the first, second, fourth, fifth and eighth letters of the word CREATIVE. Which of the following is the middle letter of the word?
(*a*) E (*b*) T
(*c*) C (*d*) A

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Directions (Qs. No. 15 to 18): *Which one of the given responses would be a meaningful order of the following words?*

15. 1. Amoeba 2. Oyster
3. Worm 4. Cow
(*a*) 1, 3, 2, 4 (*b*) 1, 2, 3, 4
(*c*) 4, 3, 2, 1 (*d*) 3, 2, 4, 1

16. 1. Birth 2. Death
3. Childhood 4. Infancy
5. Adolescence 6. Adulthood
7. Old age
(*a*) 2, 6, 7, 5, 4, 3, 1 (*b*) 1, 4, 3, 5, 6, 7, 2
(*c*) 1, 4, 3, 6, 5, 7, 2 (*d*) 2, 7, 6, 4, 5, 3, 1

17. 1. Police 2. Punishment
3. Crime 4. Judge
4. Judgement
(*a*) 3, 1, 2, 4, 5
(*b*) 1, 2, 4, 3, 5
(*c*) 5, 4, 3, 2, 1
(*d*) 3, 1, 4, 5, 2

18. 1. Orange 2. Indigo
3. Red 4. Blue
5. Green 6. Yellow
7. Violet
(*a*) 7, 2, 4, 5, 6, 1, 3 (*b*) 7, 2, 4, 6, 5, 1, 3
(*c*) 7, 2, 6, 4, 5, 1, 3 (*d*) 7, 2, 6, 4, 1, 5, 3

Directions (Qs. Nos. 19 and 24): *Arrange the given words in the sequence in which they occur in the dictionary.*

19. 1. Clone 2. Climate
3. Clutter 4. Create
5. Clapped
(*a*) 52143 (*b*) 51234
(*c*) 52134 (*d*) 53124

20. 1. Lasted 2. Loop
3. Lake 4. Litter
5. Listed
(*a*) 31542 B. 31254
(*c*) 31245 (*d*) 31452

21. 1. Intricate 2. Interview
3. Intransigent 4. Interrogation
5. Intravenous
(*a*) 2, 4, 5, 3, 1 (*b*) 5, 3, 1, 2, 4
(*c*) 4, 2, 3, 5, 1 (*d*) 3, 5, 2, 1, 4

22. 1. Forge 2. Forget
3. Forgo 4. Forgive
5. Format
(*a*) 1, 2, 4, 3, 5
(*b*) 5, 2, 4, 3, 1
(*c*) 1, 4, 3, 2, 5
(*d*) 3, 4, 5, 2, 1

23. 1. Forecast 2. Forget
3. Foreign 4. Forsook
5. Force
(*a*) 3, 5, 1, 2, 4 (*b*) 5, 1, 3, 2, 4
(*c*) 5, 1, 3, 4, 2 (*d*) 5, 1, 2, 3, 4

24. 1. Fenestration 2. Feather
3. Feed head 4. Feature
5. Feminine
(*a*) 2, 4, 3, 5, 1 (*b*) 4, 2, 3, 1, 5
(*c*) 2, 4, 1, 5, 3 (*d*) 4, 2, 3, 5, 1

25. Arrange the given words in the sequence in which they occur in the Dictionary and locate the last word.
(*a*) Frankenstein (*b*) Frankincense
(*c*) Frankalmoign (*d*) Frauendienst

26. Grouping of words are given. Choose the next word in the series from the given options.
AFGHAN, INDEFINITELY, SYNOPSIS, STUPENDOUS, BURST
(*a*) GLACIAL (*b*) COMPANION
(*c*) RESCRIPT (*d*) HIJACKER

ANSWERS

1	2	3	4	5	6	7	8	9	10
(*c*)	(*a*)	(*b*)	(*c*)	(*a*)	(*c*)	(*b*)	(*b*)	(*a*)	(*d*)
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
(*a*)	(*a*)	(*c*)	(*d*)	(*a*)	(*b*)	(*d*)	(*a*)	(*c*)	(*d*)
21	**22**	**23**	**24**	**25**	**26**				
(*c*)	(*a*)	(*b*)	(*a*)	(*d*)	(*d*)				

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Relationship Concept

While attempting questions on blood relations, one should be clear of all the relation patterns that can exist between any two individuals. These type of questions are given mainly to test one's relationship ability.

Very well known relations are :

Mother	Grandmother
Father	Grandfather
Son	Grandson
Daughter	Granddaughter
Brother	Brother-in-law
Sister	Sister-in-law
Niece	Father-in-law
Nephew	Mother-in-law
Uncle	Son-in-law
Aunt	Daughter-in-law
Husband	Cousin
Wife	

The patterns of some relationships which help in solving questions in these tests are :

Father's *or* Mother's Father	—	Grandfather (Paternal *or* Maternal)
Father's *or* Mother's Mother	—	Grandmother (Paternal *or* Maternal
Father's *or* Mother's Son	—	Brother
Father's *or* Mother's Daughter	—	Sister
Father's Brother	—	Paternal Uncle
Father's Sister	—	Paternal Aunt
Mother's Brother	—	Maternal Uncle
Mother's Sister	—	Maternal Aunt
Uncle *or* Aunt's Son *or* Daughter	—	Cousin
Son's Wife	—	Daughter-in-law
Daughter's Husband	—	Son-in-law
Husband's *or* Wife's Brother	—	Brother-in-law
Husband's *or* Wife's Sister	—	Sister-in-law
Brother's Wife	—	Sister-in-law
Sister's Husband	—	Brother-in-law
Brother's Son	—	Nephew
Brother's Daughter	—	Niece

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MULTIPLE CHOICE QUESTIONS

Directions : *In each of the following questions keenly study the relationship mentioned between the persons, and then from the given options select the right relationship as the answer.*

1. 'A' is the father of 'B' and 'C'. 'B' is the son of 'A' but 'C' is not the son of 'A'. What is 'C's' relation with 'A'?
(a) Daughter (b) Son
(c) Niece (d) Nephew

2. A lady said, "The person standing there is my grandfather's only son's daughter". How is the lady related to the standing person?
(a) Sister (b) Mother
(c) Aunt (d) Cousin

3. Ravi is the brother of Amit's son's son. What is Amit's relation to Ravi?
(a) Cousin (b) Father
(c) Grandfather (d) Son

4. Mayank said, "My mother is the sister of Rajat's brother." What is Rajat's relation with Mayank?
(a) Cousin (b) Maternal uncle
(c) Uncle (d) Brother-in-law

5. Introducing Lily, Raghav said, "Her father is my mother's only son". How is Lily related to Raghav?
(a) Aunt (b) Daughter
(c) Mother (d) Sister

6. Ajay is the brother of Vijay. Mili is the Sister of Ajay. Sanjay is the brother of Rahul and Mehul is the daughter of Vijay. Who is Sanjay's Uncle?
(a) Rahul (b) Ajay
(c) Mehul (d) Data inadequate

7. Adity is Bhavi's brother, Bharat is Jayant's father. Ella is Bhavi's mother. Aditya and Jayant are brothers. What is Ella's relationship with Bharat?
(a) Sister (b) Mother
(c) Daughter (d) Wife

8. A man introduced the boy coming with him as "He is son of the father of my wife's daughter". What relation did the boy bear to the man?
(a) Son-in-law (b) Son
(c) Brother (d) Father

9. A and B are two brothers. C is sister of B. D is sister of E. E is son of A. Who is D's uncle?
(a) D (b) E
(c) B (d) C

10. Varun said pointing towards Arun, "He is my sister's only brother's son". How is Arun related to Varun?
(a) Son (b) Brother
(c) Nephew (d) Data insufficient

11. Pointing to a man, a lady said, "His brother's father is my grandfather's only son." How is the lady related to the man?
(a) Mother (b) Sister
(c) Daughter (d) Aunt

12. Vidya is the wife of Gopi and Gopi is the brother of Akhil. Akhil is the uncle of Vijay. What is Vijay's relation with Vidya?
(a) Son (b) Nephew
(c) Brother-in-law (d) Brother

13. If Amit's father is Billoo's father's only son and Billoo has neither a brother nor a daughter, what is the relationship between Amit and Billoo?
(a) Uncle - Nephew
(b) Father- Daughter
(c) Father - Son
(d) Cousins

14. A is the sister of B. B is the son of C, and E is the daughter of D, and sister of A. What is D to C?
(a) Brother (b) Husband
(c) Wife (d) Data is inadequate

15. A Man said to a lady, "Fagu's mother is the only daughter of your father". How is the lady related to Fagu?
(a) Daughter (b) Sister
(c) Wife (d) Mother

16. Pointing to a man, a woman said, "He is the only son of my mother's mother". How is the woman related to the man?
(a) Aunt (b) Daughter
(c) Niece (d) Sister

17. If B's mother was A's mother's daughter, how was A related to B?
(a) Uncle (b) Aunt
(c) Sister (d) Data is insufficient

18. Pointing to a woman in the photograph a man said, "She is the daughter of my grandmother's only son. How is the woman related to the man?
(a) Mother (b) Daughter
(c) Sister-in-law (d) Sister

19. A man and a woman are sitting in a room. Man's mother-in-law and woman's mother-in-law are mother and daughter respectively. Man is the ..... of the woman.
(a) Father (b) Father-in-law
(c) Uncle (d) Grandfather-in-law

20. Pointing to Suman, Amit said, "He is my sister's only brother's son". How is Suman related to Amit?
(a) Grandson
(b) Son
(c) Nephew
(d) Cannot be determined

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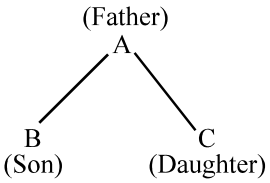
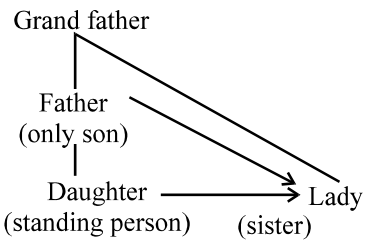
EXPLANATORY ANSWERS

1. (a) :



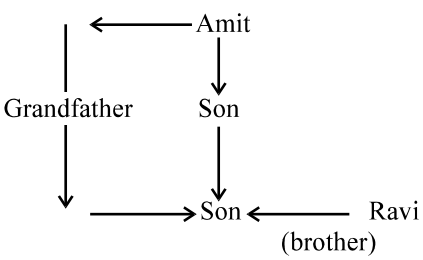
'C' is not the son of 'A', but 'A' is the father of 'C'. So, 'C' is the daughter of 'A'.

2. (a) :



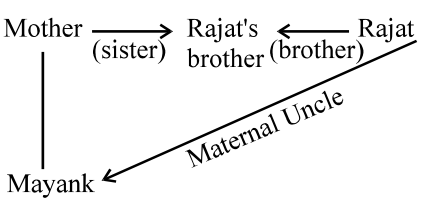
Lady's grandfather's son is lady's father and father's daughter will only be lady's sister.

3. (c) :



Amit's son's son is Amit's grandson. Ravi is the brother of Amit's son's son. So, Amit is also the grandfather of Ravi.

4. (b) :



Mayank's mother is the sister of Rajat's brother. So Rajat is also the brother of Mayank's mother. Relation of the brother with his sister's child is maternal. So Rajat is Mayank's maternal uncle.

5. (b) : The relation is : Mother
↑ (Son)
Raghav
↓ (Father)
Lily (Daughter)

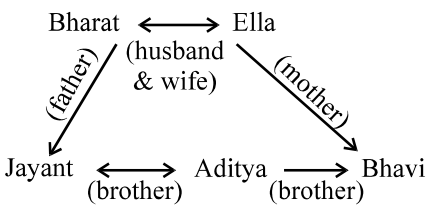
'My mother's only son' means Raghav himself. 'Her father' means Lily's father; i.e. Raghav and so, Lily is Raghav's daughter.

6. (d) : 1. Mili ⟶ Ajay ⟶ Vijay
(sister) (brother)
↓
Mehul
(daughter)

2. Sanjay ⟶ Rahul
(brother)

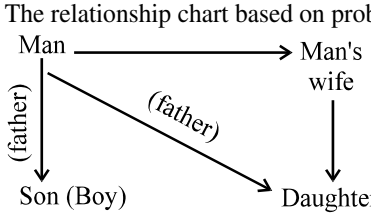
There are two sets of relationship. Information given is incomplete and no relation can be established between the two sets.

7. (d) : The relationship chart based on problem is :



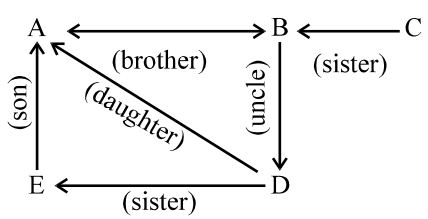
Jayant and Aditya are brothers. If Aditya is Bhavi's brother, then Jayant is also Bhavi's brother. If Bharat is Jayant's father, then he is also the father of Aditya and Bhavi. If Ella is Bhavi's mother, then she is also the mother of Aditya and Jayant. This means Bharat and Ella are husband and wife and the parents of three.

8. (b) : The relationship chart based on problem is :



'Father of the man's wife's daughter' is the man himself and the boy in question is the man's son.

9. (c) : The relationship chart based on the problem is :



When D is sister of E, who is son of A then D is daughter of A. Brother of A is B and so, B is D's uncle.

10. (a) : Varun ⟶ Sister
(only brother)
(father)
↓
Arun
(son)

Varun's sister's only brother is Varun himself and Arun is his son.

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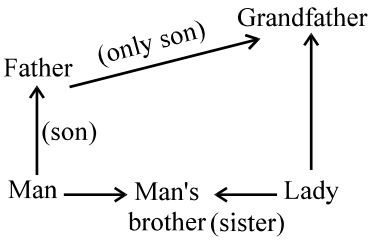
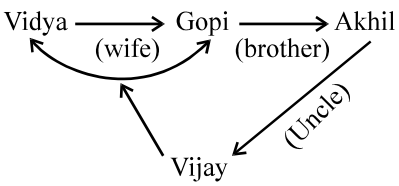
11. (b) :



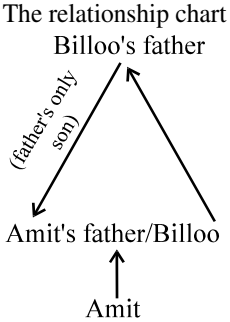
Man's brother's father is also the lady's father as he is the only son of lady's grandfather. So, the lady is man's sister.

12. (b) : The relationship chart based on problem is :



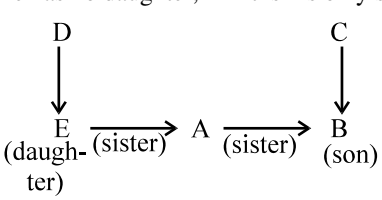
Vidya is wife of Gopi who is brother of Akhil. So, Vidya is sister-in-law of Akhil. If Akhil is uncle of Vijay then Gopi will naturally be the uncle of Vijay as it is not specified that any of the mentioned persons are Vijay's parents. Now, when Vijay is Gopi's nephew then he will also be Vidya's nephew.

13. (c) : The relationship chart based on problem is :



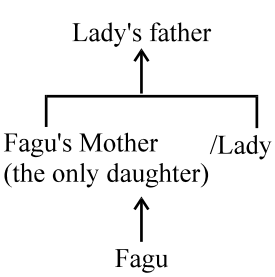
Amit's father is Billoo's father's only son means Billoo is the only son in question also, he is the father of Amit. It must be noted that Billoo has no brother which means he is single and also, when he has no daughter, Amit is his only son.

14. (d) :



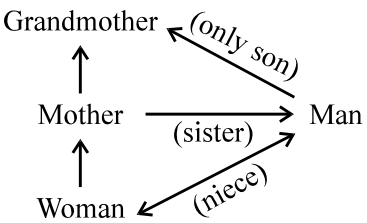
Information about 'D' and 'C' is not given as such no relation can be specified.

15. (d) :



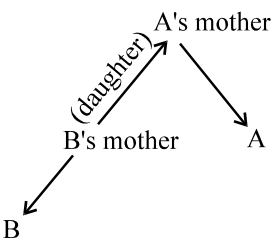
The only daughter of Lady's father is Fagu's mother.

16. (c) :



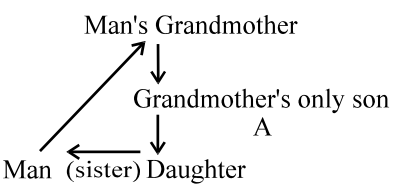
The man is the brother of the woman's mother. So, the woman is man's niece.

17. (d) :



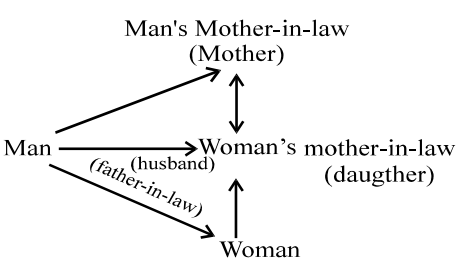
Sex of 'A' is not known. Either option A or B is correct.

18. (d) :



'My grandmother's only son' is the father of the man, and 'daughter of my grand-mother's only son' is the sister of the man.

19. (b) :



Woman's mother-in-law is the daughter of Man's mother-in-law. So, the man is the husband of woman's mother-in-law and the father-in-law of the woman.

20. (b) : Amit ⟷ Amit's Sister
(only brother)
↓
Son (Suman)

'My sister's only brother's is Amit himself and 'Sister's only brother's son' is the son of Amit i.e., Suman is the son of Amit.

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CHAPTER 11

Analysis

In these type of questions, a few statements are given. Certain facts are broken up and mentioned in these statements. What is required is to analyse the statements, arrange and sort out the given facts and then answer the questions related to the given statements.

SOLVED EXAMPLES

1. Icecream is as cold as snow. Ice is not as cold as hail. Flakes are not as cold as ice but colder than icecream. What is the coldest?
(a) Hail (b) Icecream (c) Flakes (d) Ice (e) Snow
Ans. (a) : The order showing an increase in coldness, is Icecream/Snow, Flakes, Ice, Hail.

2. *Read the following statements and answer the questions a and b.*

Five men Heavy, Fat, Thin, Short and Tall are running one behind the other. Of the Heavy and the Tall man one is an Artist and the other is Talkative. Thin man who is a Genius is in the centre. Short man is not Dark and the one who is Fair is ahead of Thin man. The Heavy man, who is not an Artist, is in front of the Fat man.

a. Who is Fair?
(a) Tall man (b) Fat man (c) Short man (d) Heavy man (e) Thin man
Ans. ***(b)***

b. What is the Tall Man?
(a) Genius (b) Talkative (c) Artist (d) Dark (e) Fair
Ans. (c)
The chart of the characteristics of five men is :
Heavy man is Talkative.
Fat man is Fair.
Thin man is Genious.
Short man is not Dark.
Tall man is the artist.

MULTIPLE CHOICE QUESTIONS

1. Among five friends, A is heavier than B; C is lighter than D; B is lighter than D but heavier than E. Who among them is the heaviest?
(a) B (b) C
(c) A (d) Can't say

2. Pune is bigger than Jhansi, Sitapur is bigger than Chittor. Raigarh is not as big as Jhansi, but is bigger than Sitapur. Chittor is not as big as Sitapur. Which is the smallest?
(a) Jhansi (b) Pune
(c) Chittor (d) Sitapur

3. Ajay works more than Ram. Alok works as much as Raju. Pankaj works less than Alok. Ram works more than Alok. Who works the most of all?

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(a) Ajay (b) Ram
(c) Alok (d) Raju

4. Vipul is taller than Hans. Hans is taller than Anand. Alok is taller than Ashok. Ashok is taller than Hans. Who among them is the tallest?
(a) Vipul (b) Alok
(c) Ashok (d) Cannot be determined

5. Pramod is taller than Gopal. Gopal is shorter than Madhu. To find out who among them is the tallest, which of the following further informations is necessary?
(a) Madhu is taller than Gopal.
(b) Madhu is shorter than Pramod's brother
(c) Pramod is taller than Madhu.
(d) Pramod is taller than Madhu's brother.

6. Among five friends P, Q, R, S and T, who is the youngest? To arrive at the answer which of the following information given in the statements (A) and (B) is sufficient?
(A) R is younger than P and T.
(B) S is younger than Q.
(a) Only A alone is sufficient
(b) Either A or B is sufficient
(c) Both A and B together are needed
(d) Both A and B together are not sufficient

7. Sushma is richer than Rashmi whereas Anand is richer than Priya. Arun is as rich as Rashmi. Shoba is richer than Sushma.
Which of the following statements is correct according to the above propositions?
(a) Rashmi is poorer than Priya.
(b) Priya is richer than Arun
(c) Arun is poorer than Sushma.
(d) Anand is richer than Rashmi

8. A is elder to B while C and D are elder to E who lies between A and B. If C be elder to B, which one of the following statements is necessarily true?
(a) E is elder to B (b) A is elder to C
(c) C is elder to D (d) D is elder to C

9. Vikram is taller than Rajan but shorter than Annie. Jamal is taller than Annie. Sita is taller than Vikram. Rajan is shorter than Sita. Who is the shortest of all in the group?
(a) Sita (b) Rajan
(c) Vikram (d) Cannot be determined

10. Suresh is as much older than Kamal as he is younger than Prabodh. Navin is as old as Kamal. Which of the following statements is wrong?
(a) Suresh is older than Navin
(b) Kamal is younger than Suresh
(c) Prabodh is not the oldest
(d) Navin is younger than Prabodh

11. Ashok is heavier than Gopal. Mahesh is lighter than Jayesh. Prashant is heavier than Jayesh but lighter than Gopal. Who among them is the heaviest?
(a) Gopal
(b) Jayesh
(c) Prashant
(d) Ashok

12. Subodh's marks in English are as much more than Gopal's marks in History as less than Pramod's marks in English. To find out Subodh's marks in English, which of the following informations given in the statements (A) and (B) is/ are sufficient?
(A) Gopal's marks in History.
(B) Pramod's marks in History.
(a) Both A and B together are needed
(b) Only B is sufficient
(c) Either A or B is sufficient
(d) Both A and B together are not sufficient

13. Pramod is older than Jayesh and Sudhir. Vikas is younger than Anil. To find out who among them is the oldest, which of the following further information will be required, if any?
(a) Sudhir is older than Jayesh
(b) Anil is older than Jayesh
(c) Vikas is older than Pramod
(d) Vikas is younger than Pramod

14. Ashok is younger than Prabir and Gopal. Sohan is younger than Prabir but older than Gopal. Which of the following statements is definitely true?
(a) Ashok is older than Sohan
(b) Sohan is the oldest among them
(c) Gopal is younger than Ashok
(d) Gopal is next to the youngest among them

15. Among five boys, Vasant is taller than Manohar, but not as tall as Raju. Jayant is taller than Datta, but shorter than Manohar. Who is the tallest in their group?
(a) Raju
(b) Manohar
(c) Vasant
(d) Cannot be determined

16. A and D study in the same class. K and L study in the same class. In which class does D study? To answer the above question, which of the following informations given in the statements A and B is/are necessary?
(A) D studies one standard below L.
(B) A's elder brother studies with K.
(a) Both A and B together are not sufficient
(b) Both A and B together are needed
(c) Only A is sufficient
(d) Only B is sufficient

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Directions (Qs. 17-18) : *(A) Gopal is shorter than Ashok but taller than Kuhav; (B) Navin is shorter than Kuhav; (C) Jayesh is taller than Navin; (D) Ashok is taller than Jayesh.*

17. Who among them is the tallest?
(a) Gopal (b) Ashok
(c) Jayesh (d) Navin

18. Which of the following informations is not necessary to answer the above question?
(a) A (b) B
(c) C (d) D

Directions (Qs. 19-20) : *Five men A, B, C, D and E read a newspaper. The one who reads first gives it to C. The one who reads last had taken from A. E was not the first or last to read. There were two readers between B and A.*

19. B passed the newspaper to whom?
(a) E (b) B
(c) A (d) None of these

20. Who read the newspaper last?
(a) E (b) B
(c) D (d) Cannot be determined

EXPLANATORY ANSWERS

1. (d) : The five friends in descending order of weight are : A/D, B/C, E or A/D, B, C/E. Either A or D is the heaviest.
2. (c) : The order of cities in descending order of size is : Pune, Jhansi, Raigarh, Sitapur, Chittor.
3. (a) : On the basis of doing work, the descending order will be : Ajay, Ram, Alok/Raju, Pankaj.
4. (d) : On the basis of height, the descending order will be Vipul/Alok, Ashok, Hans, Anand. Either Vipul or Alok is the tallest.
5. (c) : According to the information both Pramod and Madhu are taller than Gopal. Option (c) decides who is the tallest.
6. (d) : Statements are not inter-related.
7. (c) : On the basis of wealth, the descending order will be :
   1. Shobha, Sushma, Rashmi/Arun
   2. Anand, and Priya
   (The two statements are not inter-related.)
8. (a) : The order in descending seniority will be : A/C/D, E, B.
9. (b) : On the basis of height the descending order will be :
   Jamal/Sita, Annie, Vikram, Rajan.
   or
   Jamal, Sita/Annie, Vikram, Rajan.
10. (c) : On the basis of age the descending order will be : Prabodh, Suresh, Kamal/Navin.
11. (d) : On the basis of weight, the descending order will be : Ashok, Gopal, Prashant, Jayesh, Mahesh.
12. (d) : Comparison in marks do no clarify Subodh's marks in a subject.
13. (c) : On the basis of age the descending order will be :
   1. Pramod, Jayesh/ Sudhir
   and
   2. Anil, Vikas
   Option (c) connects these two statements.
14. (d) : On the basis of age the descending order will be : Prabir, Sohan, Gopal, Ashok.
15. (a) : The boys in descending order of height will be: Raju, Vasant, Manohar, Jayant, Datta.
16. (a) : There is no useful information in either of the two statements.
17. (b) : On the basis of height the descending order will be :
   Ashok, Gopal/Jayesh, Kuhav, Navin
   or
   Ashok, Gopal, Kuhav/Jayesh, Navin.
18. (c)
19. (d) : The men read the newspaper in this order : B, C, E, A, D, and B passed the newspaper to C.
20. (c) : See answer 19 explanation.

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Judgement

MULTIPLE CHOICE QUESTIONS

1. Eileen is planning a special birthday dinner for her husband's 35th birthday. She wants the evening to be memorable, but her husband is a simple man who would rather be in jeans at a baseball game than in a suit at a fancy restaurant. Which restaurant below should Eileen choose?

(*a*) Alfredo's offers fine Italian cuisine and an elegant Tuscan decor. Patrons will feel as though they've spent the evening in a luxurious Italian villa.

(*b*) Pancho's Mexican Buffet is an all-you-can-eat family style smorgasbord with the best tacos in town.

(*c*) The Parisian Bistro is a four-star French restaurant where guests are treated like royalty. Chef Dilbert Olay is famous for his beef bourguignon.

(*d*) Marty's serves delicious, hearty meals in a charming setting reminiscent of a baseball clubhouse in honor of the owner,Marty Lester, a former major league baseball all-star. Answer & Explanation

2. The film director wants an actress for the lead role of Lucy who perfectly fits the description that appears in the original screenplay. He is not willing to consider actresses who do not resemble the character as she is described in the screenplay, no matter how talented they are. The screenplay describes Lucy as an average-sized, forty something redhead, with deep brown eyes, very fair skin, and a brilliant smile. The casting agent has four actresses in mind.

1. Actress #1 is a stunning red-haired beauty who is 5'9" and in her mid-twenties. Her eyes are brown and she has an olive complexion.
2. has red hair, big brown eyes, and a fair complexion. She is in her mid-forties and is 5'5".
3. is 5'4" and of medium build. She has red hair, brown eyes, and is in her early forties.
4. is a blue-eyed redhead in her early thirties. She's of very slight build and stands at 5'.

(*a*) 1, 2 (*b*) 2, 3
(*c*) 1, 4 (*d*) 2, 4

3. The school principal has received complaints from parents about bullying in the school yard during recess. He wants to investigate and end this situation as soon as possible, so he has asked the recess aides to watch closely. Which situation should the recess aides report to the principal?

(*a*) A girl is sitting glumly on a bench reading a book and not interacting with her peers.

(*b*) Four girls are surrounding another girl and seem to have possession of her backpack.

(*c*) Two boys are playing a one-on-one game of basketball and are arguing over the last basket scored.

(*d*) Three boys are huddled over a handheld video game, which isn't supposed to be on school grounds. Answer & Explanation

4. Mrs. Carson took a taxi to meet her three friends for lunch. They were waiting for her outside the restaurant when she pulled up in the car. She was so excited to see her friends that she left her tote bag in the taxi. As the taxi pulled away, she and her friends took notice of the license plate number so they would be able to identify the car when they called the taxi company.

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1. The four women seem to agree that the plate starts out with the letter J.
2. Three of them agree that the plate ends with 12L.
3. Three of them think that the second letter is X, and a different three think that the third letter is K.

The four license plate numbers below represent what each of the four women thinks she saw. Which one is most likely the license plate number of the taxi?

(*a*) JXK 12L (*b*) JYK 12L
(*c*) JXK 12I (*d*) JXX 12L

5. Zachary has invited his three buddies over to watch the basketball game on his wide-screen television. They are all hungry, but no one wants to leave to get food. Just as they are arguing about who should make the food run, a commercial comes on for a local pizze-ria that delivers. The phone number flashes on the screen briefly and they all try to remember it. By the time Zachary grabs a pen and paper, each of them recollects a different number.

1. All of the men agree that the first three numbers are 995.
2. Three of them agree that the fourth number is 9.
3. Three agree that the fifth number is 2.
4. Three agree that the sixth number is 6; three others agree that the seventh number is also 6.

Which of the numbers is most likely the telephone number of the pizzeria?

(*a*) 995-9266 (*b*) 995-9336
(*c*) 995-9268 (*d*) 995-8266

6. Mark is working with a realtor to find a location for the toy store he plans to open in his town. He is looking for a place that is either in, or not too far from, the center of town and one that would attract the right kind of foot traffic. Which of the following locations should Mark's realtor call to his attention?

(*a*) a storefront in a new high-rise building near the train station in the center of town whose occupants are mainly young, childless professionals who use the train to commute to their offices each day.
(*b*) a little shop three blocks away from the town's main street, located across the street from an elementary school and next door to an ice cream store
(*c*) a stand-alone storefront on a quiet residential street ten blocks away from the town's center
(*d*) a storefront in a small strip mall located on the outskirts of town that is also occupied by a pharmacy and a dry cleaner

7. The neighborhood block association has received many complaints about people knocking on doors and soliciting money for an unknown charity organization even though door-to-door solicitation is prohibited by local laws. Three residents have provided descriptions individuals who have come to their door asking for money.

Solicitor #1 is a white male, 20-25 years old, 5'9", 145 pounds, with very short brown hair. He was wearing a dark blue suit and carrying a brown leather briefcase.

Solicitor #2 is a white male, 25-30 years old, 6'2", 200 pounds, with a shaved-head. He was wearing a red T-shirt and jeans.

Solicitor #3 is a white male, approximately 23 years old, 5'10", slight build, with short brown hair. He was wearing a blue suit.

Three days after the block association meet- ing, a resident noticed a man knocking on doors in the neighborhood and phoned the police to report the illegal activity. This solic- itor was described as follows:

Solicitor #4 is a white male, 22 years old, 140 pounds, about 5'10", with short brown hair. He was carrying a briefcase and wearing a dark suit.

Based on this description, which of the three solicitations was also likely carried out by Solicitor #4?

(*a*) #1, #2, and #3
(*b*) #1, but not #2 and #3
(*c*) #1 and #3, but not #2
(*d*) #1 and #2, but not #3

8. Rita, an accomplished pastry chef who is well known for her artistic and exquisite wedding cakes, opened a bakery one year ago and is surprised that business has been so slow. A consultant she hired to conduct market research has reported that the local population doesn't think of her shop as one they would visit on a daily basis but rather a place they'd visit if they were celebrating a special occasion. Which of the following strategies should Rita employ to increase her daily business?

(*a*) making coupons available that entitle the coupon holder to receive a 25% discount on wedding, anniversary, or birthday cakes
(*b*) exhibiting at the next Bridal Expo and having pieces of one of her wedding cakes available for tasting
(*c*) placing a series of ads in the local newspaper that advertise the wide array of breads
(*d*) moving the bakery to the other side of town

9. Dr. Miller has a busy pediatric dentistry practice and she needs a skilled, reliable hygienist to keep things running smoothly. The last two people she hired were recommended by top dentists in the area, but they each lasted less than one month. She is now in desperate need of a hygienist who can

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competently handle the specific challenges of her practice. Which one of the following candidates should Dr. Miller consider most seriously?

(*a*) Marilyn has been a hygienist for fifteen years, and her current employer, who is about to retire, says she is the best in the business. The clientele she has worked with consists of some of the wealthiest and most powerful citizens in the county.

(*b*) Lindy recently graduated at the top of her class from one of the best dental hygiene programs in the state. Prior to becoming a dental hygienist, Lindy spent two years working in a day care center.

(*c*) James has worked as a dental hygienist for three years in a public health clinic. He is very interested in securing a position in a private dental office.

(*d*) Kathy is an experienced and highly recommended dental hygienist who is also finishing up a degree in early childhood education, which she hopes will get her a job as a preschool teacher. She is eager to find a job in a pediatric practice, since she has always wanted to work with children.

10. Mrs. Jansen recently moved to Arizona. She wants to fill her new backyard with flowering plants. Although she is an experienced gardener, she isn't very well-versed in what plants will do well in the Arizona climate. Also, there is a big tree in her backyard making for shady conditions and she isn't sure what plants will thrive without much direct sunlight. Her favorite gardening catalog offers several backyard seed packages. Which one should Mrs. Jansen choose?

(*a*) The Rainbow Collection is ideal for North-east gardens. It includes a variety of colorful perennials that thrive in cool, moist conditions.

(*b*) The Greenhouse Collection will blossom year after year if planted in brightly lit locations and watered regularly.

(*c*) The Treehouse Collection will provide lush green plants with delicate colorful flowers that thrive in shady and partially shady locations.

(*d*) The Oasis Collection includes a variety of perennials that thrive in dry climates and bright sunlight.

EXPLANATORY ANSWERS

1.(*d*) : Since Eileen's husband does not enjoy fancy restaurants, choices a and c can be ruled out. Choice b, although casual, doesn't sound as though it would be the kind of special and memorable evening that Eileen is looking for. Choice d, which is owned by a former baseball star and is described as "charming" and "reminiscent of a baseball clubhouse", sounds perfect for Eileen's husband, who is described as a baseball fan and a man with simple tastes.

2.(*b*) : 2 and 3 possess most of the required traits. They both have red hair and brown eyes, are average-sized, and are in their forties. 1 is very tall and is only in her mid-twenties. She also has an olive complexion. 4 is of very slight build and is in her early thirties. She also has blue eyes.

3.(*b*) : Seeing four girls surrounding another girl, while in possession of her backpack, is the most suspicious of the incidents described.

4.(*a*) : The four women seem to agree that the plate starts out with the letter J. Three of them agree that the plate ends with 12L. Three of them think that the second letter is X, and a different three think that the third letter is K. The plate description that has all of these common elements is "Option A".

5.(*a*) : All of the men agree that the first three numbers are 995. Three of them agree that the fourth number is 9. Three agree that the fifth number is 2. Three agree that the sixth number is 6; three others agree that the seventh number is also 6. "Option A" is the best choice because it is made up of the numbers that most of the men agree they saw.

6.(*b*) : This option is both near the center of town and in a location (near a school and an ice cream store) where children and their parents are sure to be around. This is the only option that meets both of Mark's requirements.

7.(*c*) : The solicitor described as #2 has a shaved head and is much taller and heavier than the solicitors described as #1 and #3. Therefore, choices a and d, which include #2, can be ruled out. Solicitors #1, #3, and #4 have such similar descriptions that the correct answer is clearly choice c.

8.(*c*) : This is the only option that would encourage people to think of the bakery as a shop they would visit regularly and not just on special occasions.

9.(*b*) : The situation described indicates that Dr. Miller's practice presents some specific challenges, namely that it is a busy environment with a child clientele. There is also some indication that even highly recommended, experienced hygienists might not be cut out for Dr. Miller's office. There is nothing to suggest that Marilyn (choice a) or James (choice c) would be a good fit for Dr. Miller's practice. Kathy (choice d) has experience and she is also interested in working with children. However, the fact that she hopes to become a preschool teacher in the not-too-

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distant future indicates that she might not be the kind of committed, long-term employee that Dr. Miller needs. Lindy (choice b), with her hands-on experience working with children as well as a degree from a prestigious dental hygiene program, is the most attractive candidate for the position based on the situation described

10.(c) : The Treehouse Collection is the only package that can thrive in shady locations. Choice a requires a Northeastern climate. Choices b and d require bright sunlight.

In this type of tests certain categories of information are given followed by certain criteria. Further, the candidates are given a few cause that needs to be analysed. They are required to take the right decision, from the given options, after comparing the information in each case with the given information and criteria.

DECISION MAKING

MULTIPLE CHOICE QUESTIONS

Directions (Qs. 1 to 5) : *Read the following information carefully and answer the questions given below it.*

Following are the criteria for admitting a student in the first year engineering course in a college.

The student must—

(i) have passed XII standard examination in science with at least 80% marks.

(ii) not be more than 20 years old as on 1. 8. 1998.

(iii) have secured at least 90 marks in the entrance test out of a total of 150 marks.

(iv) be able to pay Rs. 15,000 as tuition fees for the first semester and Rs. 5,000 admission charges at the time of taking admission.

In the case of a candidate, who satisfies all other criteria except at—

(a) *(iv)* above but can pay at least 60% of the stipulated fees, the case may be referred to the Admission Committee.

(b) *(iii)* above but has secured more than 95% marks in the XIIth standard examination, the case may be referred to Chairman–Admissions.

You are given the following cases as on 1. 8. 1998. Depending upon the information provided in each case and based on the criteria mentioned above, recommend your decision. You are not to assume anything. If the information provided is not adequate to take a decision, mark 'Data inadequate' as the answer.

1. Subodh Mohaptara was 19 years old as on 20th December, 1997. He has secured 98% marks in XIIth standard examination with science and 80 marks in the entrance test. He can pay the requisite tuition fees and admission charges.
(a) Admit
(b) Refer to Admission Committee
(c) Data inadequate
(d) Do not admit
(e) Refer to Chairman–Admissions

2. Reema Jaiswal was born on 20th July, 1978. She has secured 85% and 75% marks in XIIth standard with science and entrance test respectively. She can pay the requisite tuition fees and admission charges.
(a) Refer to Chairman–Admission
(b) Refer to Admission Committee
(c) Data inadequate
(d) Do not admit
(e) Admit

3. Ashok Dubey was born on 27th November, 1978. He has secured 90% marks in the XIIth standard examination with science and 95 marks in the entrance test. He can pay Rs. 10,000 tuition fees and Rs. 3,500 admission charges.
(a) Admit
(b) Data inadequate
(c) Refer to Admission Committee
(d) Do not admit
(e) Refer to Chairman–Admissions

4. Sudha Mirchandani has secured 95% marks in XIIth standard science stream and 70% marks in the entrance test. She can pay only 65% of the requisite tuition fees and admission charges.
(a) Do not admit
(b) Admit
(c) Data inadequate
(d) Refer to Chairman–Admissions
(e) Refer to Admission Committee

5. Salil Malhotra was born on 25th September in 1979. He has secured 85% and 95% marks in the XIIth standard examination in science stream and entrance test respectively. He can pay the requisite tuition fees and admission charges.
(a) Admit
(b) Do not admit
(c) Refer to Chairman–Admissions
(d) Refer to Admission Committee
(e) Data inadequate

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Directions (Qs. 6 to 12) : *Read the following information to answer the given questions :*

Following are the criteria for selecting candidates for Research Fellowship :
The candidate must—

(i) be a post–graduate with minimum of 65% marks.

(ii) not be more than 30 years as on 15. 10. 1993.

(iii) have at least 3 years research experience.

(iv) have diploma in Statistics.

(v) have secured at least 50% marks in the entrance test.

(vi) have finalised the topic for research.

However, in case a candidate who fulfills all other criteria except

(a) (iii) above, but has M. Phil degree, should be referred to Dean.
(b) (iv) above, should be referred to Chairman.
(c) (i) above, but has at least 55% marks in post–graduation and 65% in the entrance test, should be given fellowship.
(d) (v) above, but has at lest 45% marks, should be wait–listed.

Based on these criteria and information provided below, decide the course of action in each case. You are not to assume anything. If the data provided is not adequate to decide the given course of action, your answer will be "data inadequate". These cases are given to you as on 15. 10. 1993.

6. 26 years old, Mamta Deo is a post graduate with 58%. She has got four years' research experience and has finalised topic for research. She got 70% marks in diploma in Statistics and 54% marks in the entrance examination.
(a) Fellowship not to be granted
(b) Refer to Dean
(c) Refer to Chairman
(d) Grant Fellowship
(e) Data inadequate

7. Shushila Nair has 65% marks in her post–graduation and is M. Phil. She has 5 years research experience. She has secured 65% in the entrance test and has finalised the research topic. Her date of birth is 11. 8. 65.
(a) Grant fellowship
(b) Wait–list
(c) Refer to Dean
(d) Refer to Chairman
(e) Data inadequate

8. Ameer Khan has got 58% in the entrance test. He has 68% in his post-graduation and 55% in M. Phil. He has got diploma in Statistics and has also finalised the topic for research.
(a) Grant Fellowship
(b) Refer to Dean
(c) Refer to Chairman
(d) Wait-list
(e) Data inadequate

9. 28 years old Neetu Singh is M. Phil with 60% marks. She has secured 70% marks in entrance examination and has finalised the topic for research. She has also got diploma in Statistics.
(a) Grant Fellowship
(b) Fellowship not to be granted
(c) Refer to Chairman
(d) Refer to Dean
(e) Data inadequate

10. Sadhana Suman has got diploma in Statistics with 60% marks and post-graduation with 56% marks. Her date of birth is 12. 12. 1968. She has got one year research experience and is still doing her M. Phil. She has secured 65% marks in entrance exam and has also finalised the research topic.
(a) Grant Fellowship
(b) Fellowship not to be granted
(c) Refer to Dean
(d) Data inadequate
(e) Wait-list

11. Amar Sikka is 28 years old and has got 65% marks in post-graduation and 60% marks in M. Phil. He has got 65% marks in entrance examination and has finalised the topic for research. He also has a diploma in Statistics.
(a) Grant Fellowship
(b) Fellowship not to be granted
(c) Refer to Dean
(d) Refer to Chairman
(e) Data inadequate

12. Madan Paul has got 5 years' research experience and has finalised the research topic. He has got 56% marks in post-graduation. His date of birth is 15. 2. 1966. He has also got diploma in Statistics. He got 70% marks in the entrance test.
(a) Grant Fellowship
(b) Fellowship not to be granted
(c) Refer to Dean
(d) Data inadequate
(e) None of these

Directions (Qs. 13 to 19) : *Read the following information to answer the given questions :*

Following are the conditions for selecting candidates for Research Fellowship :

The candidate must—

(i) be a post-graduate with minimum of 60% marks.

(ii) not be more than 30 years as on 1. 9. 1993.

(iii) have at least 3 years' research experience.

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(iv) have diploma in statistics.

(v) have secured at least 55% marks in the entrance test.

(iv) have finalised the topic for research.

However, in the case of a candidate who fulfills all other criteria except—

(a) *(iii)* above but has M. Phil degree, should be given fellowship.

(b) *(iv)* above should be referred to Dean.

(c) *(i)* above but has atleast 55% marks in post–graduation, should be wait-listed.

(d) *(v)* above but has atleast 50% marks, should be referred to Chairman.

Based on these criteria and information provided below, decide the course of action in each case. You are not to assume anything. If the data provided is not adequate to decide the given course of action, your answer will be "data inadequate". These cases are given to you as on 1. 9. 1993.

13. Vijay Gupta is 24 years old and has got 58% marks in the entrance examination. He has secured 63% marks in his post-graduation and 55% marks in M. Phil. He has got diploma in Statistics and has also finalised the topic for research.
(a) Grant Fellowship
(b) Refer to Dean
(c) Refer to Chairman
(d) Wait-list
(e) Data inadequate

14. Ajoy Dwivedi has secured 65% marks in the post-graduation and has secured 5 years research experience. He has secured 65% marks in the entrance test and has finalised the research topic. His date of birth is 11. 8. 1965.
(a) Grant Fellowship
(b) Wait-list
(c) Refer to Dean
(d) Data inadequate
(e) None of these

15. Madan Soren has got diploma in Statistics with 60% marks and post-graduation with 56% marks. His date of birth is 12. 12. 1968. He has got 1 year research experience and is still doing his M. Phil. He has secured 60% marks in the entrance exam and has also finalised the research topic.
(a) Grant fellowship
(b) Fellowship not to be granted
(c) Refer to Dean
(d) Data inadequate
(e) Wait-list

16. 26 years old Mamta Kulkarni is M. Phil with 60% marks. She has secured 70% marks in the entrance examination and has finali-sed the topic for research. She has also got diploma in Statistics.
(a) Grant Fellowship
(b) Fellowship not to be granted
(c) Refer to Chairman
(d) Refer to Dean
(e) Data inadequate

17. Chander Manoj has got 5 years' research experience and has finalised the research topic. He has got 56% marks in post-graduation and 60% marks in the entrance test. His date of birth is 15. 2. 1966. He has also got diploma in Statistics.
(a) Grant Fellowship
(b) Fellowship not to be granted
(c) Refer to Dean
(d) Data inadequate
(e) None of these

18. Raman Hooda is 28 years old and has got 65% marks in Post-graduation and 60% marks in M. Phil. He has got 65% marks in the entrance examination and has finalised the topic for research. He also has a diploma in Statistics.
(a) Grant Fellowship
(b) Fellowship not to be granted
(c) Refer to Dean
(d) Refer to Chairman
(e) Data inadequate

19. 26 years old Janaki Deo is a post-graduate with 58% marks. She has got four years research experience and has finalised the topic for research. She got 70% marks in the diploma in Statistics and 54% marks in the entrance examination.
(a) Fellowship not to be granted
(b) Refer to Dean
(c) Refer to Chairman
(d) Grant Fellowship
(e) Data inadequate

Directions (Qs. 20 to 27) : *Read the following information carefully and answer the questions given below :*

Following are the criteria of promotion from Junior Officer's Cadre to Senior Officer's Cadre in an organisation :

The candidate must—

(a) have completed atleast 5 years in the organisation.

(b) have secured 65% marks in the written test for promotion.

(c) have secured 60% marks in the Group Discussion.

(d) have secured 70% marks in the interview.

(e) have good record of his work performance.

(f) have good communication skill and get along well with his colleagues.

(g) not be more than 40 years and less than 30 years as on 1. 9. 93.

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(h) have good academic record with an average of at least 65% marks.

However, in the case of a candidate who—

(i) satisfies all other conditions except *(d)* above but has secured 75% marks in the written test and 65% marks in he Group Discussion, the case is to be referred to the General Manager (Personnel)–GM(P) for the decision.

(j) satisfies all other criteria except (*h*) above but has secured an average of more than 60% marks, the case is to be referred to the Managing Director (MD) of the organisation.

Now read the information provided in the case of each candidate in each of the questions given below and decide on the basis of the information provided and based on the above conditions, which of the courses of action you would suggest. These cases are given as on 5. 9. 1993. (Remember you are not to assume anything which is not provided in the question). If complete information is not provided, the answer would be Data inadequate.

20. 38 years old Rajesh has secured 65% marks in the written test for promotion, 73% marks in interview and 62% marks in Group Discussion. He has good record of his work performance, good communication skills and gets along well with his colleagues. He has good academic record with an average of 61% marks and has completed 7 years in the organisation.
(a) Refer to GM(P)
(b) Refer to MD
(c) Promote
(d) Do not promote
(e) Data inadequate

21. 34 years old Sudha has secured 60% marks in the written test for promotion, 72% marks in interview and 69% marks in Group discussion. She has good communication skill and gets along well with her colleagues. Her record of work performance is good and she has completed 6½ years in the organisation.
(a) Refer to MD
(b) Do not promote
(c) Refer to GM(P)
(d) Promote
(e) Data inadequate

22. Surekha has secured 70% marks in written test for promotion, 69% marks in Group Discussion and 72% marks in the interview. She has a good academic record with an average of 67% marks. She has good record of work performance and gets along well with her colleagues. She has good communication skill and has completed 7 years in the organisation.
(a) Do not promote
(b) Promote
(c) Refer to GM(P)
(d) Refer to MD
(e) Data inadequate

23. 39 years old Pawan has secured 66% marks in written promotion test and has a good academic record with an average of 62% marks. He has secured 65% marks in Group Discussion and 72% marks in interview. He has good record of his work performance, communication skill and gets along well with his colleagues. He has completed 6 years in the organisation.
(a) Do not promote
(b) Refer to MD
(c) Refer to GM(P)
(d) Promote
(e) Data inadequate

24. 34 years old Sudhir has secured 76% marks in the written test for promotion, 66% marks in Group Discussion and 67% marks in interview. He has good academic record with an average of 68% marks, good communication skill and gets along well with his colleagues. His work performance is good and he has completed 6 years in the organisation.
(a) Promote
(b) Refer to MD
(c) Refer to GM(P)
(d) Do not promote
(e) Data anadequate

25. 32 years old Manjula has good academic record with an average of 66% marks. She has secured 67% marks in Group Discussion, 75% marks in interview and 60% marks in written test for promotion. She has good communication skill and gets along well with her colleagues. She has good record of her work performance and has completed 7 years in the organisation.
(a) Do not promote
(b) Refer to MD
(c) Promote
(d) Refer to GM(P)
(e) Data inadequate

26. 31 years old Krishna secured 65% marks in written test for promotion, 72% marks in interview and 62% marks in Group Discussion. He has good academic record with an average of 67% marks and good communication skill. He has completed 9 years in the organisation. He gets easily annoyed and irritated with his colleagues and his record of work performance since the last two years is just average.
(a) Promote (b) Refer to GM(P)
(c) Refer to MD (d) Do not promote
(e) Data inadequate

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27. 33 years old Neelima has secured 63% marks in Group Discussion, 71% marks in interview and 66% marks in written test for promotion. She hase good academic record with an average of 68% marks and has good communication skill. She gets along well with her colleagues and has good record of her work performance. She has completed 6 years in the organisation.

(a) Refer to GM(P)
(b) Do not promote
(c) Promote
(d) Refer to MD
(e) Data inadequate

EXPLANATORY ANSWERS

1. (e) : Criterion (iii) is not satisfied but Criterion (b) gives the decision.
2. (d) : Both Criterion (iii) and Criterion (b) are not satisfied.
3. (c) : Criterion (iv) is not satisfied but Criterion (a) gives the decision.
4. (c) : Criterion (ii) is not given.
5. (a)
6. (a) : Both Criterion (i) and Criterion (c) are not satisfied.
7. (d) : Criterion (iv) is not given but Criterion (b) gives the decision.
8. (e) : Both Criteria (ii) and (iii) are not given and Criterion (a) alone cannot give the decision.
9. (e) : Both Criterion (i) and Criterion (iii) are not given and criterion (a) alone cannot give the decision.
10. (b) : Both Criterion (iii) and Criterion (a) are not satisfied.
11. (c) : Criterion (iii) is not satisfied but Criterion (a) gives the decision.
12. (a) : Criterion (i) is not satisfied but Criterion (c) gives the decision.
13. (a) : Criterion (iii) is not satisfied but Criterion (a) gives the decision.
14. (c) : Criterion (iv) is not satisfied but Criterion (b) gives the decision.
15. (b) : Both Criterion (iii) and Criterion (a) are not satisfied.
16. (e) : Criterion (i) is not given and Criterion (c) is not satisfied.
17. (e) : Criterion (i) is not satisfied but Criterion (c) gives the decision of "wait–list." This option is not given.
18. (a) : Criterion (iii) is not satisfied but Criterion (a) gives the decision.
19. (a) : Both Criterion (i) and Criterion (iii) are not satisfied, Criterion (c) and Criterion (d) gives different decisions.
20. (b) : Criterion (h) is not satisfied but Criterion (j) gives the decision.
21. (b) : Criterion (b) is not satisfied.
22. (e) : Criterion (g) is not given.
23. (b) : Criterion (h) is not satisfied but Criterion (j) gives the desicion.
24. (c) : Criterion (d) is not satisfied but Criterion (i) gives the decision.
25. (a) : Criterion (b) is not satisfied.
26. (d) : Both Criterion (e) and Criterion (f) are not satisfied.
27. (c) :

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CHAPTER 13

Statement Conclusion

In this reasoning pattern, a statement is given followed by two conclusions. The statement is to be taken as the fact. Then based on it one has to decide which of the conclusion(s) definitely follows or does not follow from the given statement.

MULTIPLE CHOICE QUESTIONS

Directions (Qs. 1 to 20): *In the following questions, each question has a statement followed by two conclusions. Taking the statement to be true, decide which of the given conclusions definitely follows from the given statement. Indicate your answer as (a) if only I follows; (b) if only II follows; (c) either I or II follows; (d) if neither I nor II follows; and (e) if both I and II follow.*

1. *Statement* : The Principal humiliated the teacher in the presence of students.
Conclusions I : The Principal did not like the teacher.
II : The teacher was not popular amongst his students.

2. *Statement* : Good health is dependent on right eating habits. Most of the people do not follow any rule regarding eating.
Conclusions I : Most of the people have poor health.
II : People are ignorant of proper eating habits.

3. *Statement* : Until our country achieves economic equality and political freedom, democracy would be meaningless.
Conclusions I : Political freedom and democracy go hand in hand.
II : Economic equality leads to real political freedom and democracy.

4. *Statement* : Black cloud follows thunder. Rains follow thunder.
Conclusions I : Thunder is the cause of rain.
II : Black cloud is the cause of thunder.

5. *Statement* : Practice is better than precept. Most doctors are heavy smokers.
Conclusions I : Most doctors cannot advise people not to smoke.
II : Doctors do not regard smoking as injurious.

6. *Statement* : Workers feel highly motivated when they get sense of involvement by participating in the management of companies.
Conclusions I : Workers should be motivated to produce more.
II : Workers should be allowed to participate in the management of companies.

7. *Statement* : Industrial revolution which first of all started in Europe has brought about modern age.
Conclusions I : Disparity between rich and poor results in revolution.
II : Revolution overhauls society.

8. *Statement* : America's defence secretary reiterated that they would continue to supply arms to Pakistan.
Conclusions I : Pakistan is incapable of manufacturing arms.
II : It would ensure peace in the region.

9. *Statement* : Poor people are more trust-worthy as compared to the rich. They can do wonders if they are taken into confidence.
Conclusions I : Poor people are wonderful people.
II : By and large rich people are not trustworthy.

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10. *Statement* : Government has spoiled many top ranking financial institutions by appointing bureaucrats as Directors of these institutions.
Conclusions I : Government should appoint Directors of the financial institutes taking into consi-deration the expertise of the person in the area of finance.
II : The Director of the financial institute should have exper-tise commensurate with the financial work carried out by the institute.

11. *Statement* : The Constitutional amendment carried out just last month prohibits the employment of child labour in any organisation.
Conclusions I : The employers must now abide by this amendment to the Constitution.
II : Children below 14 years will now be engaged in acquiring education.

12. *Statement* : People who speak too much against the dowry are those who had taken it themselves.
Conclusions I : It is easier said than done.
II : People have double standards.

13. *Statement* : Vegetable prices are soaring in the market.
Conclusions I : Vegetables are becoming a rare commodity.
II : People cannot eat vegetables.

14. *Statement* : As far as the rate of literacy is concerned, there is hardly any difference between the States of Kerala and West Bengal, but one is ahead of the other in respect of the percentage of population unemployed.
Conclusions I : Unemployment is more in Kerala than in West Bengal.
II : West Bengal has higher unemployment than Kerala.

15. *Statement* : He tirelessly argues for the replacement of the present system of allocating work to the teaching staff in the department by another system which will give the teachers higher job satisfaction.
Conclusions I : No system is free from problems and therefore there should be no system.
II : Any system you may evolve but it should give higher job satisfaction to the teachers.

16. *Statement* : The unequal allocation of funds by the Government for literacy and employment generation programmes stands out clearly when we analyse the attitude of government towards these two areas.
Conclusions I : Government has more favourable attitude towards literacy programmes than employment generation programmes.
II : Government has more favourable attitude towards employment generation programmes than literacy programmes.

17. *Statement* : Amul chocolates sold enough in comparison to all other chocolate brands in India.
Conclusions I : No other chocolate is sold in India.
II : The selling data of every chocolate brand is available in India.

18. *Statement* : Wearing Khadi is not only good for our health but also for our nation.
Conclusions I : Economy of India also depends upon Khadi sector.
II : It is difficult to maintain Khadi clothes.

19. *Statement* : Ideas given by our ancestors that were once discarded as uneconomical and unviable, turn out to be as functional and inevitable in present circumstances.
Conclusions I : In ancient period ideas were considered either completely functional or totally infeasible.
II : Ideas cannot change from time-to-time.

20. *Statement* : The Supreme Court gave a judgement that the maintenance of old age parents is the responsibility of the married girls, if they do not have brothers.
Conclusions I : Constitution is always interpreted to help oppressed people out.
II : Before the Supreme Court gave its verdict, a married girl must have denied to pay for the maintenance of her parents.

Directions (Qs. 21 to 25): *In the following questions, the symbols *, $\overset{*}{=}$,=, @ and $\underset{=}{\overset{@}{}}$ are used with the following meanings :*

(a) * (b) means (a) is greater than (b),

(a) $\overset{*}{=}$ (b) means (a) is either greater than or equal to (b).

(a) = (b) means (a) is equal to (b).

(a) @ (b) means (a) is smaller than (b) and

(a) $\underset{=}{\overset{@}{}}$ (b) means (a) is either smaller than or equal to (b).

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Answer is given as:

(*a*) If only conclusion I is true;

(*b*) If only conclusion II is true;

(*c*) If either I or II is true;

(*d*) If neither I nor II is true;

(*e*) If both I and II are true.

21. *Statements* : T $\overset{*}{=}$ P, P @ S, P = M
Conclusions : *I.* S * M *II.* T @ S

22. *Statements* : R $\underset{=}{@}$ M, M * P, R $\overset{*}{=}$ L
Conclusions : *I.* M = L *II.* P = L

23. *Statements* : M = T, T $\underset{=}{@}$ Z, S * M
Conclusions : *I.* Z * M *II.* Z = M

24. *Statements* : L @ C, C * Z, Z $\underset{=}{@}$ F
Conclusions : *I.* C * F *II.* F = C

25. *Statements* : Z @ B, N $\overset{*}{=}$ S, B @ N
Conclusions : *I.* B = Z *II.* S $\underset{=}{@}$ B

EXPLANATORY ANSWERS

1. (*a*) : Only conclusion I follows. Conclusion II is not confirmed by the given statement.

2. (*a*) : Conclusion I definitely follows. Conclusion II is not confirmed by the given statement.

3. (*b*) : Only conclusion II follows. Conclusion I cannot be drawn from the given statement.

4. (*b*) : Only conclusion II follows. Conclusion I is wrong as rains are the cause of thunder.

5. (*e*) : Both conclusion I and conclusion II follow from the statements as the doctors who are heavy smokers indicate that they do not regard smoking as injurious and thus, cannot advise people not to smoke.

6. (*e*) : Both conclusions I and II follow from the statement as involvement of workers boosts production and benefits the companies.

7. (*b*) : Only conclusion II follows. Conclusion I is not related the statement.

8. (*d*) : Neither conclusion I nor conclusion II follows. Both the conclusions are unrelated to the statement.

9. (*b*) : Only conclusion II follows. Conclusion I is not related to the statement.

10. (*e*) : Both conclusion I and conclusion II follow.

11. (a) **:** Only conclusion I follows. Conclusion II is not related to the statement.

12. (e) **:** Both conclusion I and conclusion II follow as people who talk too much often do not practise what they say.

13. (d) **:** Neither conclusion I nor conclusion II is confirmed by the statement.

14. (d) **:** Neither conclusion I nor conclusion II follows as the precentage of unemployment in each state is not mentioned.

15. (b) **:** Only conclusion II follows. Conclusion I runs counter to the statement as a system is necessary.

16. (d) **:** Neither conclusion I nor conclusion II is confirmed by the statement.

17. (b) **:** Only conclusion II follows as the data of every chocolate brand shows the comparision of Amul chocolates with other brands. Coclusion I is not confirmed by the statement.

18. (a) **:** Only conclusion I follows. Conclusion II is not related to the statement.

19. (d) **:** Neither conclusion I, nor conclusion II follows; both the conclusions are unrelated.

20. (b) **:** Only conclusion II follows, because the Supreme Court judgement must have come in such a case and not in vacuum.

21. (a) **:** $T \geq P, P < S, P = M$
$\therefore S > M$

22. (d) **:** $R \leq M, M > P, R \geq L$
$\therefore L \leq R \leq M$

23. (c) **:** $M = T, T \leq Z, Z = M$
If $T = Z$, then $Z = M$
If $T < Z$, then $Z > M$

24. (d) **:** $L < C, C > Z, Z \leq F$
No relation can be established between C and F.

25. (d) **:** $Z < B, N \geq S, B < N$
No relation can be established between B, S and Z.

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Syllogistic Reasoning

In this reasoning pattern two statements are followed by few conclusions drawn. Four options (*a*), (*b*), (*c*) & (*d*) are given as answers. Based on the statement the candidate has to select the right answer in each question.

MULTIPLE CHOICE QUESTIONS

Directions (Q. 1–10) : *In each question given below two statements are followed by four conclusions numbered I, II, III and IV. You have to take the two given statements to be true even if they seem to be at variance from commonly known facts. Read the statements and conclusions and decide which of the conclusions logically follows from the two given statements, disregarding commonly known facts.*

1. Statements: All the phones are scales. All the scales are calculators.
Conclusions:
I. All the calculators are scales.
II. All the phones are calculators.
III. All the scales are phones.
IV. Some calculators are phones.
(*a*) Only I and IV (*b*) Only III and IV
(*c*) Only II and IV (*d*) Only I and II

2. Statements: No door is dog. All the dogs are cats.
Conclusions:
I. No door is cat.
II. No cat is door.
III. Some cats are dogs.
IV. All the cats are dogs.
(*a*) Only II and IV (*b*) Only I and III
(*c*) Only III and IV (*d*) Only III

3. Statements: Some tables are T.V. Some T.V. are radios.
Conclusions:
I. Some tables are radios.
II. Some radios are tables.
III. All the radios are T.V.
IV. All the T.V. are tables.
(*a*) Only II and IV (*b*) Only I and III
(*c*) Only IV (*d*) None of the four

4. Statements: All men are vertebrates. Some mammals are vertebrates.
Conclusions:
I. All men are mammals.
II. All mammals are men.
III. Some vertebrates are mammals.
IV. All vertebrates are men.
(*a*) Only IV (*b*) Only II
(*c*) Only III (*d*) Only I

5. Statements: All green are blue. All blue are white.
Conclusions:
I. Some blue are green.
II. Some white are green.
III. Some green are not white.
IV. All white are blue.
(*a*) Only I and II (*b*) Only I and III
(*c*) Only I and IV (*d*) Only II and IV

6. Statements: Some pens are books. Some books are pencils.
Conclusions:
I. Some pens are pencils.
II. Some pencils are pens.
III. All pencils are pens.
IV. All books are pens.
(*a*) Only I and III (*b*) Only II and IV
(*c*) All the four (*d*) None of the four

7. Statements: All the research scholars are psychologists. Some psychologists are scientists.
Conclusions:
I. All the research scholars are scientists.
II. Some research scholars are scientists.
III. Some scientists are psychologists.
IV. Some psychologists are research scholars.
(*a*) Only III and IV (*b*) None of the four
(*c*) All the four (*d*) Only III

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8. Statements: All the goats are tigers. All the tigers are lions.

Conclusions:

I. All the goats are lions.
II. All the lions are goats.
III. Some lions are goats.
IV. Some tigers are goats.

(*a*) All the four (*b*) Only I, II and III
(*c*) Only I, III and IV (*d*) Only II, III and IV

9. Statements: All members are students. No student is a girl.

Conclusions :

I. All students are members.
II. No members is a girl.
III. Some students are members.
IV. Some members are girls.

(*a*) Only I follows (*b*) Only I, II and III follow
(*c*) All follows (*d*) Only II and III follows

10. Statements : All soaps are clean. All clean are wet.

Conclusions :

I. Some clean are soaps.
II. No clean is soap.
III. Some wet are soaps.
IV. All wet are soaps.

(*a*) Only I follows
(*b*) Only I and II follow
(*c*) Only either III and IV follow
(*d*) Only I and III follow

Directions (Q. 11–15) : *Every question below has a few statements, followed by four conclusions numbered I, II, III and IV. You have to consider every given statement as true, even if it does not conform to the well known facts. Read the conclusions and then decide which of the conclusions can be logically derived.*

11. Statements: Some keys are staplers. Some staplers are stickers. All the stickers are pens.

Conclusions:

I. Some pens are staplers.
II. Some stickers are keys.
III. No sticker is key.
IV. Some staplers are keys.

(*a*) Only I and II
(*b*) Only II and IV
(*c*) Only II and III
(*d*) Only I and IV and either II or III

12. Statements: All the locks are keys. All the keys are bats. Some watches are bats.

Conclusions:

I. Some bats are locks.
II. Some watches are keys.
III. All the keys are locks.
IV. Some keys are locks.

(*a*) Only I and II (*b*) Only I and IV
(*c*) Only II and III (*d*) Only I and III

13. Statements: All the papers are books. All the bags are books. Some purses are bags.

Conclusions:

I. Some papers are bags.
II. Some books are papers.
III. Some books are purses.
IV. Some papers are purses.

(*a*) Only I and IV (*b*) Only II and III
(*c*) Only I and II (*d*) Only I and III

14. Statements: All the bottles are boxes. All the boxes are bags. Some bags are trays.

Conclusions:

I. Some bottles are trays.
II. Some trays are boxes.
III. All the bottles are bags.
IV. Some trays are bags.

(*a*) Only III and IV (*b*) Only I and II
(*c*) Only II and III (*d*) Only I and IV

15. Statements: Some rats are cats. Some cats are dogs. No dog is cow.

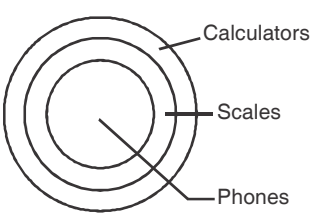
Conclusions:

I. No cow is cat.
II. No dog is rat.
III. Some cats are rats.
IV. Some dogs are cats.

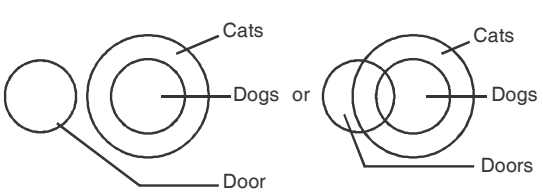
(*a*) Only I and IV (*b*) Only I and II
(*c*) Only I and III (*d*) Only III and IV

EXPLANATORY ANSWERS

1. (*c*)



2. (*d*)



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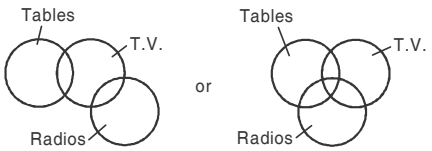
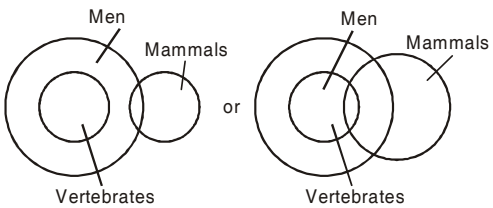
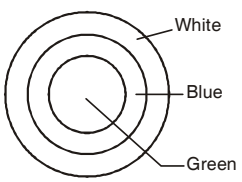
3. (*d*)



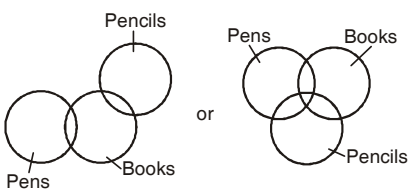
4. (*c*)



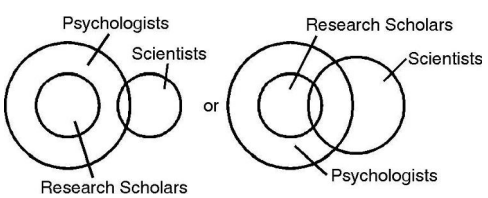
5. (*a*)



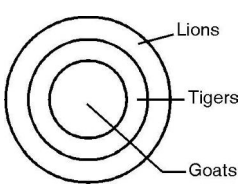
6. (*d*)



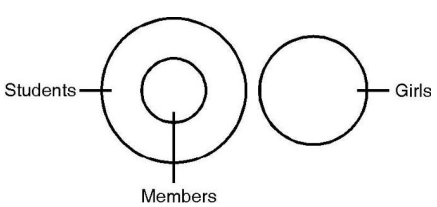
7. (*a*)



8. (*c*)

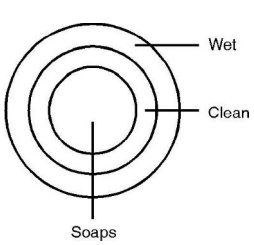


9. (*d*)



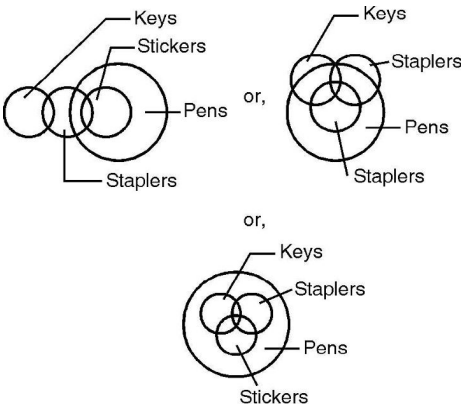
Since Members and Girls are disjoint, it follows that no members is girl. Since Members and Students have a common area, it follows that some student are members.

10. (*d*)

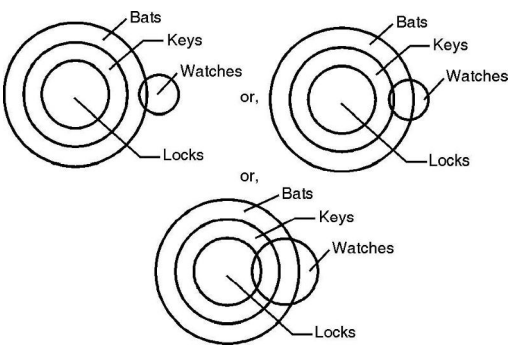


According to diagram, Clean and Soaps have a common area. So, some clean are soaps. Also wet and soaps have a common area. So, some wet are soaps.

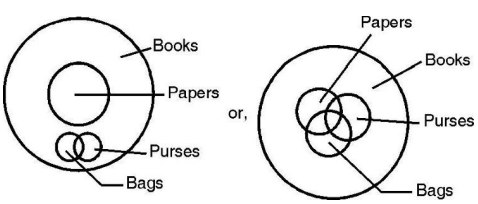
11. (*d*)



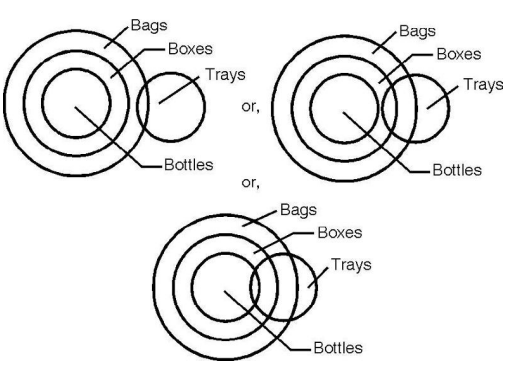
12. (*b*)



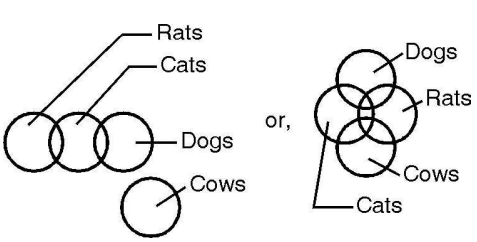
13. (*b*)



14. (*a*)



15. (*d*)



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Drawing Inferences

Questions on this type of reasoning have become quite common in competitive examinations. In this test, instead of a statement or proposition, a passage is given which is a congregation of many propositions coupled with arguments. Some inferences are given followed by the passage. The candidate has to decide whether the given inference follows, or does not follow in the light of the given passage.

SOLVED EXAMPLES

Given below are two passages followed by possible inferences which can be drawn from the facts stated in the passage. Each inference is examined separately in the context of the passage to decide upon its degree of truth or falsity. The answers are marked . . . .

(a) if the inference is "definitely true", *i.e.,* it properly follows from the statement of facts given.

(b) if the inference is "probably true," though not "definitely true" in the light of the facts given.

(c) if the "data are inadequate", *i.e.*, from the facts given you cannot say whether the inference is likely to be true or false.

(d) if the inference is "probably false", *i.e.*, though not "definitely false" in the light of the facts given.

(e) if the inference is "definitely false", *i.e.*, cannot possibly be drawn from the facts given or it contradicts the given facts.

PASSAGE I

The serious accident, in which a person was run over by a car yesterday, has again focussed attention on the most unsatisfactory state of street lighting. No one expects side roads to be provided with the same standard of lightings as a main road, but unless the council is prepared to make good its promise as regards road lighting, it will only be a question of time before there are further and perhaps fatal accidents.

1. The accident that occurred was fatal.

Ans. ***(e)*** **:** This conclusion cannot be drawn from the facts given.

2. Several accidents have so far taken place because of unsatisfactory lightings.

Ans. ***(a)*** **:** Mark the words 'again focussed attention on the most . . . lighting'.

3. There will not be a single accident on road if they are satisfactorily illuminated.

Ans. ***(c)*** **:** Data are insufficient. This statement is not confirmed by the paragraph.

4. It seems that the council has promised to improve the state of lighting on side roads.

Ans. ***(a)*** **:** Mark the words "the council is prepared to make good its promise as regards the road lighting."

5. The accident occurred at night.

Ans. ***(a)*** **:** It must be night because the passage deals with unsatisfactory state of street lighting.

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MULTIPLE CHOICE QUESTIONS

Directions : *Below are given some passages followed by several possible inferences which can be drawn from the facts stated in each passage. You have to examine each inference separately in the context of the passage and decide upon its degree of truth or falsity.*

Mark Answers	If you think...
(a) "Definitely True"	the inference properly follows from the statement of facts given.
(b) "Probably True"	the inference may be true in the light of the facts given but not definitely true.
(c) "Data Inadequate"	from the facts given it cannot be said whether the inference is likely to be true or false.
(d) "Probably False"	the inference is probably false in the light of the facts given though not definitely false.
(e) "Definitely False"	the inference cannot possibly be drawn from the facts given or it contradicts the given facts.

PASSAGE 1

Indian granite industry is in peril in the absence of a uniform policy from the state governments, despite the thrust given by liberalisation policies of the union government. Compared to the remarkable progress in the field during the last three years, the absence of matching policies by state governments had put granite quarry owners and others involved in the industry on the verge of collapse in the international market. The policies differed from state to state, had created problems as far as loyalty, dead rent and duration of lease were concerned.

1. Each state having granite quarry has set up its own rules which are contrary to the interest of the industry.

2. Till three years ago, granite production in India was not profitable.

3. The granite production is largely controlled by individuals.

4. The granite produced in India does not match with the quality of international level.

5. The union government's liberalisation policy became applicable to granite industry only during the last three years.

PASSAGE 2

Steel production has always been burdened with costs much higher than in comparable plants overseas. On the one hand custom duty on almost all steel imports has been reduced, on the other excise duty has been raised. Domestic steel products are now uncompetitive which in turn has led to the demand that both the custom and excise rates should be reviewed to prevent sickness in the industry.

6. The steel industry in general is making losses as a fall out of the government policy.

7. The cost of production of steel in other countries is less than that in India.

8. India can compete with the foreign countries in re gard to the price of steel with a favourable government policy.

9. Foreign steel has become cheaper comparative to domestic steel.

10. The government is considering lowering of excise duty on steel products.

PASSAGE 3

The annual domestic consumption of plastics in India is expected to grow between 2.5 and 3 million tonnes by the end of the Ist balls of the century from the current level of about one million tonnes. The global consumption of plastics now stands at 100 million tonnes. To sustain the present growth pattern, India would need two additional polymer plants of 1,000 tonnes every year till the turn of the Ist half of this century. Entrepreneurs should now think in lines of globalisation and promote projects of international capacity and they would have to look at technology transfer as well as upgradation and strategic and creative alliances.

11. The total domestic consumption of plastics in India is about one per cent of the global consumption.

12. At present India does not import plastics.

13. India lacks in technological capabilities in produc-ing plastics.

14. There is an expected growth of about .2 per cent in the plastic consumption every year.

15. Potentially India can be one of the major players in the production of plastics in the international market.

EXPLANATORY ANSWERS

1. (a) : The policies differed from state to state.
2. (c) : Remarkable progress during the last three years is mentioned in the paragraph but nothing suggests that the production was not profitable.
3. (a) : There is absence of a uniform policy from the state Governments.
4. (c) : According to the paragraph, absence of matching policies had put the quarry owners and others

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involved in the industry on the verge of collapse in the international market. Nothing is mentioned about the granite quality produced in India or of the international level.

5. (e) : The inference does not relate to the facts given in the statement.
6. (d) : Government policy alone may not be responsible for the losses. Cost or quality factor may also be responsible.
7. (c) : The paragraph mentions that steel production in India has always been burdened with costs much higher than in comparable plants overseas. But nowhere in the paragraph it is mentioned that the cost of production of steel is less in other countries.
8. (a) : If the government reviews its policy, India can definitely compete with the foreign countries in regard to the steel price.
9. (a) : Customs duty on almost all steel products has been reduced.
10. (b) : There is a demand that both the customs and excise rates should be reviewed.
11. (a) : The global consumption of plastics is 100 million tonnes and current level of consumption in India is 1 million tonnes.
12. (c) : The paragraph does not mention about the import or export of plastics.
13. (a) : Entrepreneurs would have to look at technology transfer as well as upgradation and strategic and creative alliances.
14. (a) : The expected growth by end of the Ist half of this century is between 2.5 and 3 million tonnes. India needs 2 additional polymer plants of 1,000 tonnes per year.
15. (a) : By thinking in lines of globalisation and promoting projects of international capacity India can be one of the major players in the production of plastics in the international market.

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Trends

This type of questions are asked to assess the thinking pattern or mental trends of the candidate. These are simple questions but should be answered honestly and carefully.

MULTIPLE CHOICE QUESTIONS

Directions : *In the questions given below four alternatives have been given below each one of them. You have to select the right alternative according to your mind and mark it in your answer sheet.*

1. I like pre-defined rules and regulations.
(*a*) Sometimes (*b*) No
(*c*) Yes (*d*) No idea

2. I found a purse full of money in college premise. I:
(*a*) donated the amount among poor
(*b*) gave it to the principal
(*c*) offered it at temple
(*d*) None of these

3. I am punctual regarding
(*a*) going to bed (*b*) time
(*c*) meals (*d*) dating

4. I was travelling on a boat which capsized. Firstly, I:
(*a*) rescued others (*b*) saved myself
(*c*) closed my eyes (*d*) cursed my luck

5. When someone asks you for help in odd situations then:
(*a*) you give him/her all possible help
(*b*) you promise him/her help
(*c*) you do not help him/her
(*d*) you turn a deaf ear

6. In case my wristwatch is out of order, I:
(*a*) would try to repair it myself
(*b*) would give it to watchmaker
(*c*) would buy a new watch
(*d*) would throw it away

7. Often I change my opinion in the last moment.
(*a*) Yes (*b*) No
(*c*) Sometimes (*d*) No idea

8. Generally I am extrovert and well behaved.
(*a*) Yes (*b*) No
(*c*) Sometimes (*d*) No idea

9. I like to use new technique of work.
(*a*) Yes (*b*) No
(*c*) Sometimes (*d*) No idea

10. When someone considers you wrong then:
(*a*) you do not react
(*b*) you consider him/her wrong
(*c*) you try to ward off the misunderstanding on proper occasion.
(*d*) you pick a fight

11. The secret of my success is:
(*a*) hard labour (*b*) awakening in night
(*c*) gossiping (*d*) luck

12. If you are a female and you are talking with a male:
(*a*) You hide your age
(*b*) You are afraid
(*c*) You talk without hesitation
(*d*) You avoid talks

13. I do like rules and regulations.
(*a*) Yes (*b*) No
(*c*) Sometimes (*d*) No idea

14. Excellent ideas come to my mind:
(*a*) while working alone
(*b*) while working in a group
(*c*) while in sleep
(*d*) while in bathroom

15. Whenever my little baby cries loudly, then I
(*a*) beat him/her
(*b*) feed milk to him/her
(*c*) make him/her sleep
(*d*) ask my husband to handle him/her

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16. When I see a mad person, I :
(*a*) approach towards him/her
(*b*) maintain distance from him/her
(*c*) throw stone at him/her
(*d*) start laughing at him/her

17. While driving my car I offer lift to people who ask for lift.
(*a*) Always (*b*) Sometimes
(*c*) Never (*d*) If she is a girl

18. When someone tries to convince you then:
(*a*) You get convinced
(*b*) You do not get convinced
(*c*) You hear him/her passionately
(*d*) You turn a deaf ear

19. Whenever someone knocks on my closed door then firstly I
(*a*) open the door
(*b*) peep through the lens fitted in the door
(*c*) do not open the door
(*d*) yell at him/her

20. I speak to others about my expectation and dreams.
(*a*) Rarely (*b*) Often
(*c*) Sometimes (*d*) Never

21. Any dispute can be solved by :
(*a*) quarrelling (*b*) court
(*c*) dialogue (*d*) money

22. When I do any foolish work then :
(*a*) I feel ashamed (*b*) I feel proud of myself
(*c*) Nothing happens (*d*) I weep

23. If I were correspondent of any newspaper then I would write on the following subject :
(*a*) Cinema and theatre
(*b*) Political events
(*c*) Sports
(*d*) Stock market

24. If I were not human being then :
(*a*) I wish to be a bird (*b*) I wish to be a horse
(*c*) I wish to be God (*d*) Can't say

25. Suppose, you have worn a new shirt and your friend passed a comment that it is not looking good on you. You :
(*a*) will change the shirt immediately
(*b*) will take it lightly as it is your style
(*c*) will not change the shirt but feel offended
(*d*) will start quarrelling

26. I wish to live alone always.
(*a*) Yes (*b*) No
(*c*) Sometimes (*d*) Never

27. I want to spend my spare (extra) time :
(*a*) in reading interesting books
(*b*) in reading comics
(*c*) in viewing films
(*d*) in gossiping

28. Before doing any work I ask myself 'Is it appropriate'?
(*a*) Yes (*b*) No
(*c*) Sometimes (*d*) Never

29. If I see the GOD, I will ask for
(*a*) huge wealth (*b*) honesty
(*c*) love (*d*) heaven

30. People call you selfish.
(*a*) Always (*b*) Sometimes
(*c*) Never (*d*) No idea

31. While talking to friends I do not like to express my very personal matters.
(*a*) Yes (*b*) No
(*c*) Sometimes (*d*) Never

32. Consultation with others helps me to take a decision.
(*a*) Yes (*b*) No
(*c*) Sometimes (*d*) Never

33. After failure:
(*a*) One repents
(*b*) One tries again to succeed
(*c*) Nothing special is happened
(*d*) Nothing in life remains

34. I want to be convinced by arguments.
(*a*) Yes (*b*) No
(*c*) Sometimes (*d*) Never

ANSWERS

1	2	3	4	5	6	7	8	9	10
(*c*)	(*b*)	(*b*)	(*b*)	(*a*)	(*b*)	(*b*)	(*a*)	(*a*)	(*c*)
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
(*a*)	(*c*)	(*a*)	(*a*)	(*b*)	(*b*)	(*b*)	(*a*)	(*b*)	(*a*)
21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
(*c*)	(*a*)	(*c*)	(*a*)	(*b*)	(*c*)	(*a*)	(*a*)	(*c*)	(*c*)
31	**32**	**33**	**34**						
(*c*)	(*a*)	(*b*)	(*a*)						

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Critical

In this type of reasoning, a statement is given and assumptions are drawn from it. An assumption is something assumed, supposed and taken for granted. The implicity of the two assumptions is in question. The implication means the hidden meaning, something which is derived from and as such based upon the statement.

MULTIPLE CHOICE QUESTIONS

Directions (Qs. 1 to 6): *In each question below are given two statements followed by two conclusions numbered I and II. You have to take the two given statements to be true even if they seem to be at variance from commonly known facts and then decide which of the given conclusions logically follows from the two given statements, disregarding commonly known facts. Read both the statements and—*

Give answer (*a*) *if only conclusion I follows; give answer* (*b*) *if only conclusion II follows; give answer* (*c*) *if either I or II follows; give answer* (*d*) *if neither I nor II follows and give answer* (*e*) *if both I and II follows.*

1. *Statements I :* All tomatoes are red.
II : All grapes are tomatoes.
Conclusions I : All grapes are red.
II : Some tomatoes are grapes.

2. *Statements I :* All painters are smilling.
II : Some authors are painters.
Conclusions I : All smiling authors are painters.
II : Some authors are smiling.

3. *Statements I :* All peons in this office are efficient.
II : Ramu is not efficient.
Conclusions I : Ramu is not peon in this office.
II : Ramu should be more efficient.

4. *Statements I :* All weavers are hard working.
II : No hard working men are foolish.
Conclusions I : No weavers are foolish.
II : Some foolish are weavers.

5. *Statements I :* All fishes are cars.
II : All cars are vegetables.
Conclusions I : Some vegetables are cars.
II : Some vegetables are fishes.

6. *Statements I :* Some dogs are pups.
II : All horses are pups.

Directions (Qs. 7 to 10): *In each question below is given a statement followed by three assumptions number I, II and III. An assumption is something supposed or taken for granted. You have to consider the statement along with the assumptions and decide which of the assumptions is implicit in the statement. Then decide which of the alternatives is the correct answer.*

7. *Statement :*
"Use Riya Cold Cream for fair complexion"—an advertisement.
Assumptions :
I. People like to use cream for fair complexion.
II. People are easily fooled.
III. People respond to advertisements.
(*a*) Only I is implicit.
(*b*) Only II is implicit.
(*c*) Only I and III are implicit.
(*d*) Only I and II are implicit.
(*e*) All are implicit.

8. *Statement :*
"Slogans against smoking in office should be put on the notice board"—an employee in an office suggests.
Assumptions :
I. The employee felt that his suggestion will be considered.
II. People smoke in the office.
III. Some people will stop smoking after reading the slogans.
(*a*) Only I is implicit.
(*b*) Only I and II are implicit.
(*c*) Only II and III are implicit.

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(*d*) None is implicit.
(*e*) All are implicit.

9. *Statement :*
"I want to present him a book on techniques of yoga on his birthday"—A tells B.
Assumptions :
I. A and B will be invited for the birthday celebrations.
II. The person to whom the book is to be presented, is not keeping good health.
III. Book is the best gift for birthdays.
(*a*) Only I and II are implicit.
(*b*) Only II and III are implicit.
(*c*) Only I and III are implicit.
(*d*) None is implicit.
(*e*) All are implicit

10. *Statement :*
Keeping in view the financial constraint, the management institution has decided to charge at the time of providing employment in various organisations, a placement fee of ₹ 25000 from the organisation in which the student will be provided the employment.
Assumptions :
I. It will help in increasing the demand of the students belonging to the management institution.
II. The amount collected in this way will be purposeful.
III. It may be possible that the organisation providing employment may select less number of students in future.
(*a*) None follows.
(*b*) Only II and III follow.
(*c*) Only I follows.
(*d*) Only I and II follow.
(*e*) None of these

EXPLANATORY ANSWERS

1. (*e*) : When all tomatoes are red and all grapes are tomatoes, then all grapes are also red. When all grapes are tomatoes, then some tomatoes must be grapes. Therefore, both conclusions I and II are correct.

2. (*b*) : When all painters are smiling and some authors are painters, then some authors are smiling. Therefore, only conclusion II is correct.

3. (a) : When all the peons of the office are efficient, then Ramu cannot be a peon in this office. Therefore, only conclusion I is correct.

4. (*a*) : When all weavers are hardworking and no hardworking men are foolish, then no weavers are foolish. Therefore, only conclusion I is correct.

5. (*e*) : When all fishes are cars and all cars are vegetables, then all fishes will naturally be vegetables. This means that some vegetables are fishes. And when all cars are vegetables, then some vegetables will be cars naturally. Therefore, both the conclusions I and II are correct.

6. (*d*) : No relationship can be established between the two statements. Therefore, neither conclusion I nor conclusion II is correct.

7. (*c*) : The advertisement itself denotes that people like to use cream for fair complexion and they do respond to advertisements. Advertisements are for awareness of the product not for fooling people.

8. (*e*) : Suggestion for putting up the notice is made because some people must be smoking in office. Notice board is read by people in office and some may stop smoking after reading the slogans.

9. (*c*) : According to A presents are best gifts for birthdays and when A has bought the book he expects to be invited for the birthday celebration. Nothing is mentioned about health of the birthday person.

10. (*b*) : The amount collected will lessen the financial constraint and there is every possibility for selecting less number of students because of the fee charged.

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CHAPTER 18

Emotional Intelligence

Emotional intelligence (EI) refers to the ability to perceive, control, and evaluate emotions. Emotional intelligence (EI) is the area of cognitive ability involving traits and social skills that facilitate interpersonal behaviour. Intelligence can be broadly defined as the capacity for goal-oriented adaptive behaviour; emotional intelligence focuses on the aspects of intelligence that govern self-knowledge and social adaptation.

Emotional Intelligence that is also called Emotional Intelligence Quotient or (EQ) narrates the capability, capacity, or deftness to understand. It evaluates and manages one's emotions.

MULTIPLE CHOICE QUESTIONS

Directions: *Answer the following questions by selecting the appropriate option.*

1. In my group of friends, I am generally aware of how each person feels about the other people in our social circle.
(*a*) Strongly Agree (*b*) Agree
(*c*) Disagree (*d*) Strongly Disagree

2. When I am upset, I can usually pinpoint exactly why I am distressed.
(*a*) Strongly Agree (*b*) Agree
(*c*) Disagree (*d*) Strongly Disagree

3. While there are some things that I would like to change, I generally like who I am.
(*a*) Strongly Agree (*b*) Agree
(*c*) Disagree (*d*) Strongly Disagree

4. When I make mistakes, I often berate and criticize myself and my abilities.
(*a*) Often (*b*) Sometimes
(*c*) Rarely (*d*) Almost Never

5. I feel uncomfortable in emotionally charged situations.
(*a*) Strongly Agree (*b*) Agree
(*c*) Disagree (*d*) Strongly Disagree

6. I tend to avoid confrontations. When I am involved in a confrontation, I become extremely anxious.
(*a*) Strongly Agree (*b*) Agree
(*c*) Disagree (*d*) Strongly Disagree

7. I am generally aloof and detached until I really get to know a person.
(*a*) Strongly Agree (*b*) Agree
(*c*) Disagree (*d*) Strongly Disagree

8. I tend to overreact to minor problems.
(*a*) Often (*b*) Sometimes
(*c*) Rarely (*d*) Almost Never

9. I feel confident about my own skills, talents, and abilities.
(*a*) Strongly Agree (*b*) Agree
(*c*) Disagree (*d*) Strongly Disagree

10. I would describe myself as a good judge of character.
(*a*) Strongly Agree (*b*) Agree
(*c*) Disagree (*d*) Strongly Disagree

11. When I am facing an unpleasant task, I tend to:
(*a*) Make a plan and work on it a little each day
(*b*) Get it over with as soon as possible
(*c*) Put it off until the last minute
(*d*) Don't do it at all

12. During a heated argument, I am more likely to:
(*a*) Stop the fight and agree to a short break before resuming the discussion.
(*b*) Shut down and stop responding to the other person.
(*c*) Give in and apologize in order to quickly end the argument.
(*d*) Start insulting the other person.

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13. When making an important decision, I tend to:
(*a*) Follow my instincts
(*b*) Rely on direction from other people
(*c*) Go with the easiest option
(*d*) Guess randomly

14. Which of the following statements best describes you?
(*a*) I have an easy time making friends and getting to know new people.
(*b*) I get along well with others, but I have to really get to know someone before they become a true friend.
(*c*) I find it difficult to meet people and make friends.
(*d*) I cannot make friends.

15. You have invested a lot of time and energy into a project for one of your classes. While you feel confident about your work, your instructor gives you a C+ on the project. How do you deal with this situation?
(*a*) Decide the class is stupid and stop putting forth your best efforts.
(*b*) Berate and criticize your own work.
(*c*) Confront the instructor and ask for a better grade.
(*d*) Think about ways you could improve the project and apply these ideas to future schoolwork.

16. One of your best friends has suffered a miscarriage. How do you respond?
(*a*) Allow your friend to express her feelings and offer your support.
(*b*) Spend time with her, but avoid talking about her loss.
(*c*) Convince her to go out with some friends to get her mind off it.
(*d*) Give her some time to herself.

17. One of your co-workers has a habit that annoys you. The problem seems to be getting worse each day. How do you respond?
(*a*) Tell your co-worker what is bothering you.
(*b*) Make a complaint about the behaviour to your supervisor.
(*c*) Talk about your co-worker behind his back.
(*d*) Suffer in silence.

18. You've been feeling stressed out at work and haven't finished projects as quickly as you should. When your boss suddenly assigns you another large project, how do you feel?
(*a*) Anxious about getting all the work done.
(*b*) Overwhelmed by the task before you.
(*c*) Angry that your boss hasn't noticed how overworked you are.
(*d*) Depressed and sure that you can never finish it all.

19. If I am scheduled to meet a loved one at a certain time and that person is late, I get worried and eventually start to panic:
(*a*) Frequently (*b*) Sometimes
(*c*) Rarely (*d*) Never

20. Others do not want to spend time with me in public because my behaviour embarrasses them.
(*a*) Frequently (*b*) Sometimes
(*c*) Rarely (*d*) Never

21. I prevent being in situations where I need to show compassion and affection because I feel uncomfortable comforting others.
(*a*) Frequently (*b*) Sometimes
(*c*) Rarely (*d*) Never

22. When I am angry, I do not care about what I say or do and end up saying and doing things I regret later and need to apologize for.
(*a*) Frequently (*b*) Sometimes
(*c*) Rarely (*d*) Never

23. I feel frequently depressed and unhappy without really knowing why.
(*a*) Frequently (*b*) Sometimes
(*c*) Rarely (*d*) Never

24. If others point out my mistakes or give me negative feedback about myself, I feel ashamed, embarrassed and then become offensive and angry.
(*a*) Frequently (*b*) Sometimes
(*c*) Rarely (*d*) Never

25. Crying makes me feel better so I frequently cry when I am angry, ashamed, or embarrassed.
(*a*) Frequently (*b*) Sometimes
(*c*) Rarely (*d*) Never

ANSWERS

1	2	3	4	5	6	7	8	9	10
(*b*)	(*b*)	(*a*)	(*b*)	(*d*)	(*d*)	(*c*)	(*d*)	(*a*)	(*b*)
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
(*a*)	(*a*)	(*a*)	(*a*)	(*d*)	(*a*)	(*a*)	(*a*)	(*c*)	(*d*)
21	**22**	**23**	**24**	**25**					
(*d*)	(*d*)	(*d*)	(*d*)	(*d*)					

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CHAPTER 19

Social Intelligence

Questions on social intelligence are asked to assess the common sense of the candidate in various social situations.

MULTIPLE CHOICE QUESTIONS

Directions : *Each of the following questions is followed by four alternatives. Select the most appropriate answer.*

1. In the examination hall, you find that your question paper is too tough to be answered satisfactorily by you. The best thing you can do is:
(*a*) try cheating from your neighbouring candidate.
(*b*) leave the paper and walk out.
(*c*) try attempting those questions first of which you know something.
(*d*) complain to the examiner about the toughness of the question paper.

2. Your best friend is annoyed with you for certain reasons. You will :
(*a*) try your best to reason out your friend's annoyance.
(*b*) go out and make new friends.
(*c*) show indifference.
(*d*) remind the friend of your good friendship.

3. You were invited to a party, but on the day of the party you are informed that the party has been cancelled. You will :
(*a*) try to find out the reason for its cancellation.
(*b*) decide that you will never go to that place ever again.
(*c*) not discuss the matter with anyone.
(*d*) hold the party at your place instead.

4. You find that the cooking gas cylinder is leaking. The first thing you would do is :
(*a*) switch off the light.
(*b*) close the knob of the cylinder.
(*c*) call the fire brigade for help.
(*d*) alert all the members at home.

5. While returning home from a far away place you find that your pocket has been picked. You will :
(*a*) try to hitch-hike to home.
(*b*) hire a taxi and pay on reaching home.
(*c*) go to the nearest police station and lodge an FIR.
(*d*) call home and ask someone to pick you from the place you made the phone call.

6. Your friend has not invited you to his marriage party, you will :
(*a*) ignore the whole affair.
(*b*) send him your best wishes.
(*c*) attend the ceremony.
(*d*) hold it against him.

7. You are interviewed for a new job. Which of the following questions is most important to you?
(*a*) Remuneration you will be paid.
(*b*) Opportunities for promotion.
(*c*) Scope to develop your ideas and use them to improve the working of the organisation.
(*d*) All the above are equally important.

8. You are walking down the street and suddenly you see two hundred-rupee notes on the pavement. What action will you take?
(*a*) Give the money to beggar.
(*b*) Pocket it yourself.
(*c*) Deposit it in the nearest police station.
(*d*) Leave it as it is.

ANSWERS

1	2	3	4	5	6	7	8
(*c*)	(*a*)	(*a*)	(*b*)	(*b*)	(*b*)	(*d*)	(*c*)

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INDEXING ADDRESS MATCHING

Directions : *In each question below a combination of name and address is given in the first column at the left, followed by four such combinations, one each under the columns (a), (b), (c) and (d). You have to find out the combination which is exactly the same as the combination in the first column. The number of that column which contains that combination is the answer. If all the combinations are different, the answer is '(e)'.*

1. Triveni Atma
Opp Lal Banglow
Varanasi -221002

(*a*) Triveni Atma
Opp Lal Bangalow
Varanasi -221002

(*b*) Triveni Atma
Opp Lal Banglow
Varanasi -220012

(*c*) Triveni Atma
Opp Lal Banglow
Varanasi -221002

(*d*) Triveni Athma
Opp Lal Banglow
Varanasi -221002

2. Tara Lal Appa
Javagal street
Calicat 673005

(*a*) Tara Lal Appa
Javagal Street
Calicat 673005

(*b*) Tara Lal Appa
Javagal street
Calicut 673005

(*c*) Tara Lal Appa
Javagal street
Calicat 670035

(*d*) Tara Lal Appa
Javagal streat
Calicat 673005

3. Iqbal Rehman
Bhandri Gali
Post Box No -3097

(*a*) Iqbal Rehman
Bhandri Ghali
Post Box No -3097

(*b*) Iqbal Rehman
Bhandri Gali
Post Box No -3097

(*c*) Iqbal Rehman
Bhandri Gali
Post Box no -3097

(*d*) Iqbal Rahman
Bhandri Gali
Post Box No -3097

4. Jaganpa Shinde
Christ phot co.
Tel no -27363

(*a*) Jaganpa Shinde
Christ photo co.
Tel no -27363

(*b*) Jaganpa Shinde
Christ phot co.
Tel no -27363

(*c*) Jaganpa Shinde
Christ phot co.
Tel no -273633

(*d*) Jaganna Shinde
Christ phot co.
Tel no -27363

5. N.R. Savitri
Giri Girls hostal
Anapuram-167951

(*a*) N.R. Savitri
Giri Girls hostal
Anapuram-167951

(*b*) N.R. Savitri
Giri Girls hostel
Anapuram-167951

(*c*) N.R. Savitri
Giri Girls hostal
Anapuram-167851

(*d*) N.R. Savithri
Giri Girls hostal
Anapuram-167951

6. Madam Brulopher
Jung villa
Banjaram Hills

(*a*) Madam Bruloper
Jung villa
Banjaram Hills

(*b*) Madam Brulopher
Jung villa
Banjaram Hill

(*c*) Madam Brulopher
Jung Villa
Banjaram Hills

(*d*) Madam Brulopher
Jung villa
Banjaram Hills

7. Samartha sen
C 20/05 Guftga Bldg
B. No. - 1631

(*a*) Samartha sen
C 20/05 Guftga Blg
B. No. - 1631

(*b*) Samartha sen
C 200 Guftga Bldg
B. No. - 1631

(*c*) Samartha sen
C 20/05 Guftga Bldg
B. No. - 1631

(*d*) Samartha sen
C 20/05 Guflga Bldg
B. No. - 1631

8. Phiroz Gerabl
Harmit palace
Samaita nagar

(*a*) Phiroz Gerabi
Harmit palace
Samaita nagar

(*b*) Phiroz Gerabl
Harmit place
Samaita nagar

(*c*) Phiroz Gerabl
Harmit palace
Samaita nager

(*d*) Phiroz Gherabl
Harmit palace
Samaita nagar

9. Nitu gajadhar
Shersing Haveli
Jaipur -302006

(*a*) Nitu gajadhar
Shersing Haveli
Jaipur -302006

(*b*) Nitu gajadar
Shersing Haveli
Jaipur -302006

(*c*) Nitu gajadhar
Shersing Haveli
Jaipur -303006

(*d*) Nitu Gajadhar
Shersing Haveli
Jaipur -302006

ANSWERS

1	2	3	4	5	6	7	8	9
(*c*)	(*a*)	(*b*)	(*b*)	(*a*)	(*d*)	(*c*)	(*d*)	(*a*)

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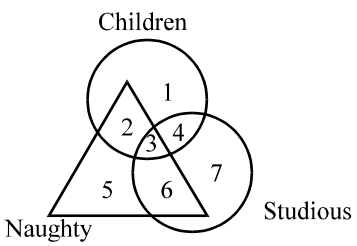
CHAPTER 20

Venn Diagrams

In these type of questions diagrammatic representation presents a logical illustration of particular class or statements based on which the questions are asked. A clear view of the diagram makes the concept clear for attempting such questions.

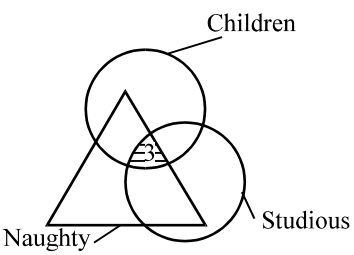
SOLVED EXAMPLE



Study the above diagram and specify the region representing children who are naughty as well as studious.

(*a*) 3 and 6 (*b*) 2 and 4
(*c*) only 3 (*d*) only 4

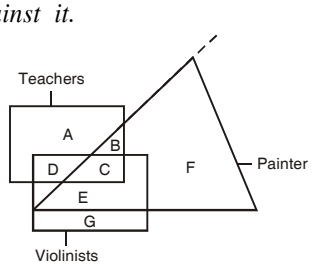
Ans. ***(c)*** **:** The explanation depicting children who are naughty as well as studious will be :



It is now clear that only region 3 represents all the three classes.

MULTIPLE CHOICE QUESTIONS

Directions (Qs. 1–3) : *In the following diagram, there are three figures interlocking each other – a rectangle, a square and a triangle. Each figure represents the class mentioned against it.*



Study the figure and answer the questions that follows.

1. Teachers who are painters but not violinists are represented by

(*a*) B (*b*) C
(*c*) D (*d*) F

2. The region which represents painters and violinists but not teachers, is denoted by

(*a*) B (*b*) D
(*c*) E (*d*) F

3. Which letter represents teachers who are painters as well as violinists?

(*a*) B (*b*) C
(*c*) D (*d*) E

Directions (Qs. 4–6) : *In the figure given below, there are three interesting circles each representing certain section of people. Different regions are marked a-g. Read the statements in each of the following questions and choose the letter of the region which correctly represents the statements?*

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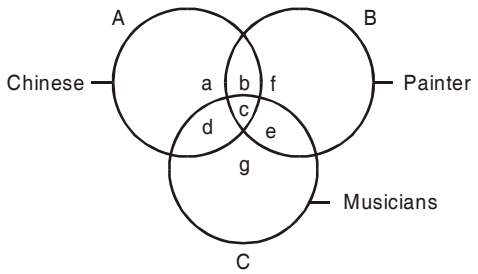
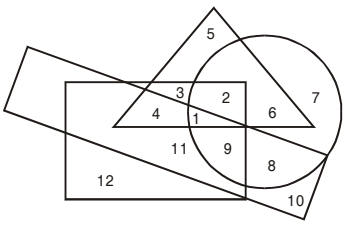


4. Chinese who are painters but not musicians?
(*a*) b (*b*) c
(*c*) d (*d*) g

5. Chinese who are musicians but not painters.
(*a*) d (*b*) c
(*c*) b (*d*) a

6. Painters who are neither Chinese nor musicians.
(*a*) b (*b*) c
(*c*) f (*d*) g

Directions (Qs. 7–10) : *In the following figure, the circle stands for employed, the square stands for hard-working, the triangle stands for rural and the rectangle stands for intelligent. Study the figure carefully and answer the questions that follow.*



7. Rural employed people who are neither intelligent nor hard-working are indicated by region.
(*a*) 10 (*b*) 9
(*c*) 6 (*d*) 4

8. Unemployed rural hard-working and intelligent people are indicated by region.
(*a*) 1 (*b*) 2
(*c*) 3 (*d*) 4

9. Rural people who are hard-working and employed but not intelligent are indicated by region.
(*a*) 1 (*b*) 2
(*c*) 3 (*d*) 4

10. Rural employed people who are neither intelligent nor hard-working are indicated by region.
(*a*) 2 (*b*) 4
(*c*) 6 (*d*) 9

EXPLANATORY ANSWERS

1. (*a*) : The persons satisfying the given conditions are represented by the region which is common to the rectangle and the triangle but not the square i.e. B.

2. (*c*) : The persons satisfying the given conditions are represented by the region which is common to the triangle and the square but is not a part of the rectangle i.e. E.

3. (*b*) : The required set of persons is represented by the letter denoting the region common to the rectangle, triangle and the square i.e. C.

4. (*a*) : The required region is the one which is common to the circles A and B and lies outside circle C i.e. b.

5. (*a*) : The required region is the one which is common to the circles A and C but is not a part of circle B i.e. d.

6. (*c*) : The required region is the one which lies inside the circle B but is not a part of either circle A or circle C i.e. f.

7. (*c*) : The required set of people is represented by the region which is common to the triangle and circle but is not a part of either the rectangle or the square i.e. 6.

8. (*d*) : The required set of people is represented by the region which lies outside the circle and is common to the triangle, square and rectangle i.e. 4.

9. (*b*) : The required set of people is represented by the region which is common to the triangle, square and circle but is not a part of the rectangle i.e. 2.

10. (*c*) : The required set of people is denoted by the region which is common to the triangle and the circle but is not a part of the rectangle i.e. 2.

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NON-VERBAL

CHAPTER 1

Series/Figural Series

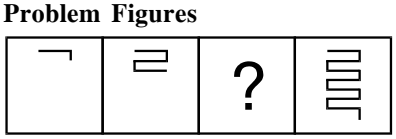
MISSING SERIES

This form of series is almost identical to the one mentioned earlier. Here too are given two sets of figures, the Problem Figures and the Answer Figures. The problem figures follow a particular pattern of movement which constitute the series. The only difference from the earlier mentioned set of series is that instead of depicting the last figure that continues the pattern here one of the middle figures needs to be depicted from-the answer figures. This type needs a little more concentration and brain work as the continuity is broken and has to be set right. Understand the set up of elements, pattern and figures in each set and try different styles and rules to find the answer.

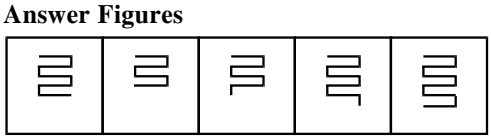
SOLVED EXAMPLES

In each question below there are two sets of figures, first problem figures and then follows the answer figures. One of the answer figures should fit into the box where a question mark is placed in the set of problem figures. The letter of the answer figure which should be considered as forming the series and should be placed in the question marked box is the answer.

1. Problem Figures



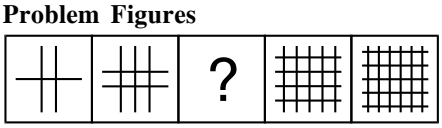
Answer Figures



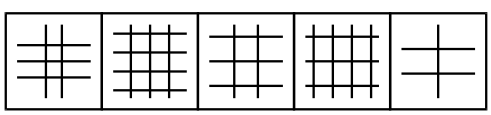
(*a*) (*b*) (*c*) (*d*) (*e*)

Answer (*a*) : Observe the set of problem figures. The design made of straight lines is becoming bigger at each step. In first figure there are two lines segments and in second figure three lines segments are increased. To continue the pattern four line segments should be increased so that further five line segments added in the last figure can complete the series. Answer figure (*a*) contains four more line segments and hence, is the right answer.

2. Problem Figures



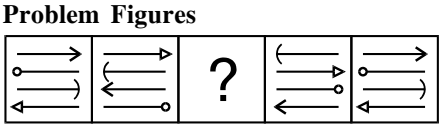
Answer Figures



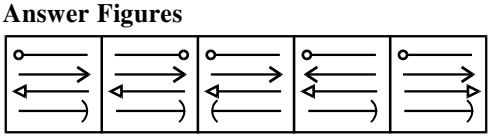
(*a*) (*b*) (*c*) (*d*) (*e*)

Answer (*d*) : Observe that at each step one vertical and one horizontal line is added. By this rule answer figure (*a*) fits in the question marked space. Note that answer figure (*b*) can also be considered in absence of option (*d*), but here the point to be noted is that the number of horizontal lines is one more than the number of vertical lines. So, answer figure (*d*), is the answer.

3. Problem Figures



Answer Figures



(*a*) (*b*) (*c*) (*d*) (*e*)

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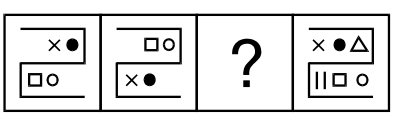
Answer (*a*) : Note that the fourth or the bottom element is made the first or the topmost element in the next figure. Similarly, the third element is made the second, the second element made the fourth and the first element made the third. Also, the direction of the elements is changed at each step. By the process mentioned above, answer figure A is the right choice to be considered as forming the series.

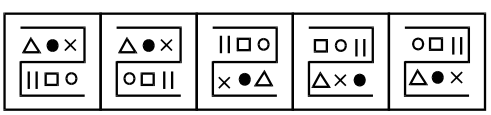
MULTIPLE CHOICE QUESTIONS

Directions : *In each of these questions, there are two sets of figures. The figures placed first are Problem Figures, and those follows are Answer Figures indicated by the letters (a), (b), (c), (d) and (e). A series is established if one of the five Answer Figures is placed at the question-marked space. Figures form a series if they change from left to right according to some specific rule. The letter of the Answer Figure which should be placed in the question-marked space is the answer. All the figures, i.e. three Problem Figures and one Answer Figure placed in the question-marked space should be considered as forming the series.*

1. Problem Figures

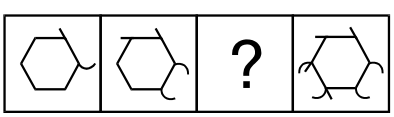


Answer Figures

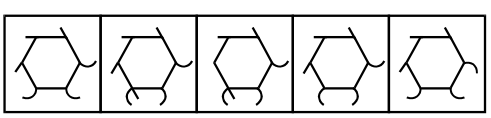


(*a*) (*b*) (*c*) (*d*) (*e*)

2. Problem Figures

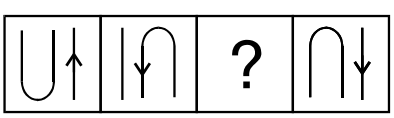


Answer Figures

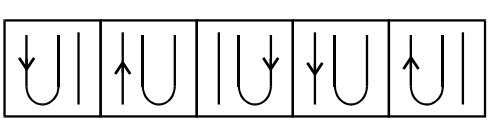


(*a*) (*b*) (*c*) (*d*) (*e*)

3. Problem Figures

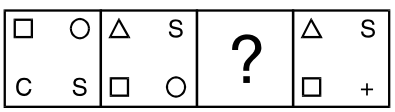


Answer Figures

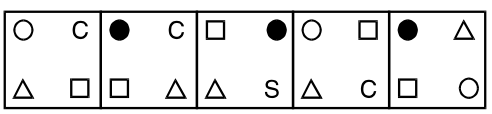


(*a*) (*b*) (*c*) (*d*) (*e*)

4. Problem Figures

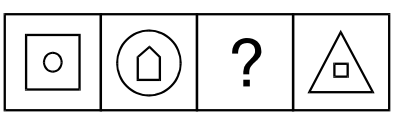


Answer Figures

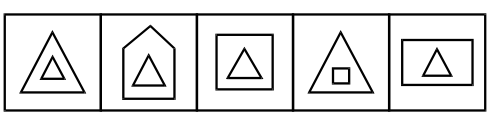


(*a*) (*b*) (*c*) (*d*) (*e*)

5. Problem Figures

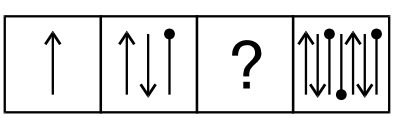


Answer Figures

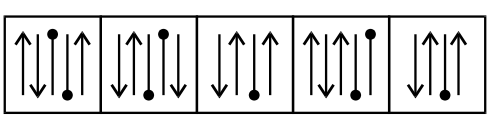


(*a*) (*b*) (*c*) (*d*) (*e*)

6. Problem Figures

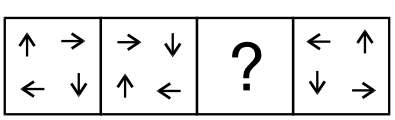


Answer Figures

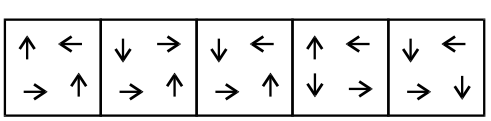


(*a*) (*b*) (*c*) (*d*) (*e*)

7. Problem Figures



Answer Figures



(*a*) (*b*) (*c*) (*d*) (*e*)

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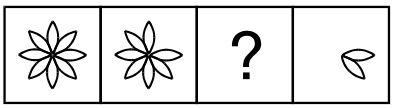
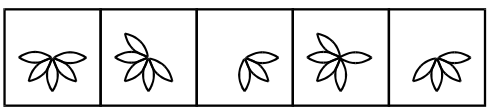
8. Problem Figures

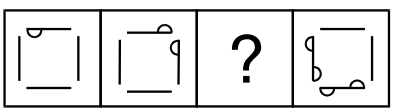


Answer Figures

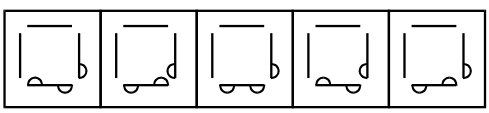


(*a*) (*b*) (*c*) (*d*) (*e*)

9. Problem Figures

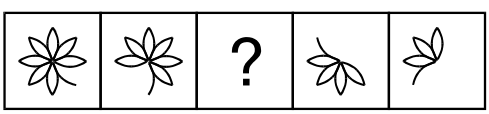


Answer Figures

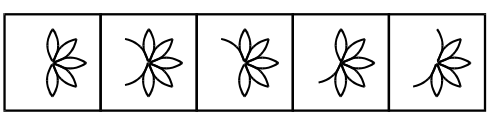


(*a*) (*b*) (*c*) (*d*) (*e*)

10. Problem Figures

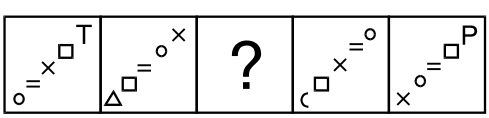


Answer Figures

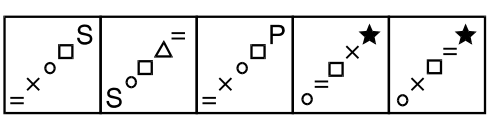


(*a*) (*b*) (*c*) (*d*) (*e*)

11. Problem Figures

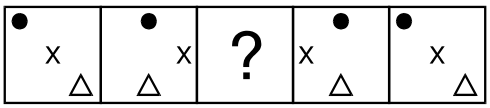


Answer Figures

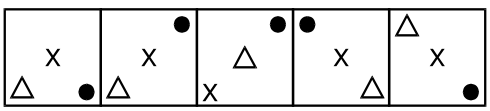


(*a*) (*b*) (*c*) (*d*) (*e*)

12. Problem Figures

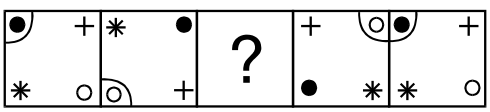


Answer Figures

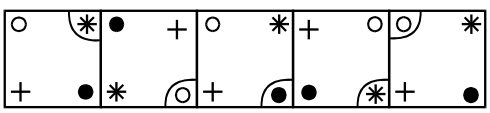


(*a*) (*b*) (*c*) (*d*) (*e*)

13. Problem Figures

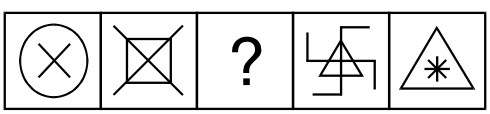


Answer Figures

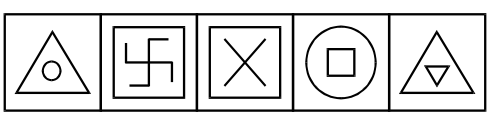


(*a*) (*b*) (*c*) (*d*) (*e*)

14. Problem Figures

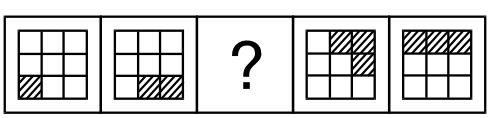


Answer Figures

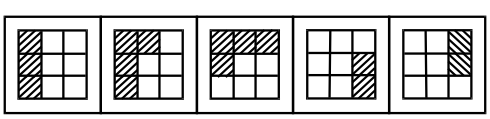


(*a*) (*b*) (*c*) (*d*) (*e*)

15. Problem Figures



Answer Figures



(*a*) (*b*) (*c*) (*d*) (*e*)

EXPLANATORY ANSWERS

1. (*c*) : From first problem figure to the second the elements on the top are shifted down and vice versa. In fourth problem figure there are three elements which, as per rule, are also shifted. So, in question marked space only option '(*c*)' can be considered as forming the series.

2. (*d*) : Anticlockwise one of the sides of the hexagon is extended and clockwise one arc is added. The direction of the arc is changed at each step. Answer figure 'D' is the right answer.

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3. (*e*) : Both the elements are turned upside down, their places interchanged and the arrow head moved left from one element to the other. In the question marked space the 'U' shape and the arrowhead should be facing upwards, the line segment should be on the right and the arrowhead should be on the extreme left. To continue the series the next figure has the 'U' shape and the arrowhead facing downwards, the line segment on the right and the arrowhead on the extreme right. Option '(*e*)' fits into the question marked space.

4. (*c*) : At each step the places of two elements on the horizontal are interchanged and clockwise one element is made new. Option '(*c*)' fits in the pattern to complete the series.

5. (*b*) : At each step the enclosed figure is enlarged in the next and a new figure is placed inside the enlarged figure. Option '(*b*)' fits into the question marked space.

6. (*a*) : The arrow and the line with the dot are increased in a set pattern in opposite directions. The series they form is two arrows and two lines with the dot which is repeated. Answer figure '(*a*)' is the right choice.

7. (*c*) : Each arrow is turned 90° clockwise at each step. Option '(*c*)' fits into the question marked space.

8. (*a*) : The number of petals removed at each step is increased by one, i.e., the petals are removed in the order of one, two and three, leaving only two petals in the last figure option '(*a*)' is the right answer.

9. (*e*) : The lines are moved clockwise. First a semicircle is added to the adjacent line. Then the semicircles on the opposite sides are added one by one on the two lines. Answer figure '(*e*)' fits into the question-marked space.

10. (*c*) : Each time one petal is removed and the half petal is clockwise and anticlockwise alternately. Answer figure '(*c*)' completes the series.

11. (*a*) : At first step the fifth or the bottom most element is moved to the second place from top, the second element moved to the fourth place, the fourth element is moved to the third place, the third element is moved to the first or the topmost place and the element on the top which is made new is moved to the last or the fifth place. At second step i.e., from second problem figure to third problem figure the above process is reversed. The bottom most element is the first and the top most element is the last or fifth. Hereafter, the process is repeated from the beginning. Option '(*a*)' is the right answer.

12. (*b*) : The three elements are moved half step everytime-first till they reach the extreme right position and then back to the left. Answer figure '(*b*)' fits into the question-marked space.

13. (*c*) : The four elements are moved one step clockwise and the arc one step anti-clockwise. Option '(*c*)' is the right answer.

14. (*b*) : The smaller design is enlarged in the next and a new smaller design is placed in its centre. Option '(*b*)' fits into the question-marked space to continue the series.

15. (*d*) : The shaded portion is moved one step anticlockwise at each step and one extra portion is shaded alternately.

FIGURAL SERIES

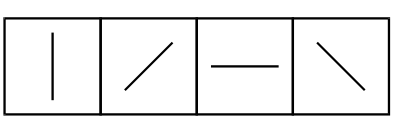
In this form of non-verbal series, which are the most common, four or five consecutive problem figures form a definite sequence and one is required to select the one figure from the given set of Answer Figures that will continue the same sequence.

One has to try different set of moves, changes, replacements, rotations, repetitions and a lot more variations to arrive at the logical pattern making the series. Practising alone will sharpen one's skill of solving such sequences.

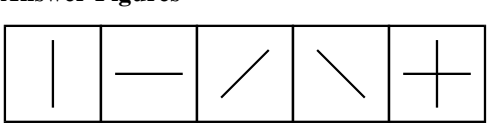
SOLVED EXAMPLES

In each of the questions given below, which one of the answer figures should come after the problem figure if the sequence were continued?

1. Problem Figures



Answer Figures



(*a*) (*b*) (*c*) (*d*) (*e*)

Answer (*a*) : All the figures are simple straight lines of the same size. Their directions and positions have changed.

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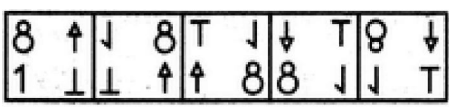
In the first figure, the line is in a vertical position, in the second, the line has moved 45° clockwise, in the third, the line has further moved 45° clockwise, and in the fourth, the line has further moved 45° clockwise. Thus, two facts are brought out: *(i)* the line moves clockwise, and *(ii)* the line moves 45° at each step.

Now the fourth figure (Problem Figures) should be moved 45° clockwise. It will be a vertical line. Thus, the next figure to continue the series will be a vertical straight line.

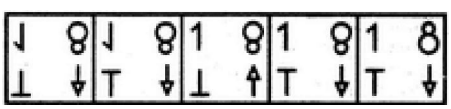
MULTIPLE CHOICE QUESTIONS

Directions : *In each of the following questions which one of the five answer figures given below should come after the problem figures if the sequence are continued?*

Problem Figures

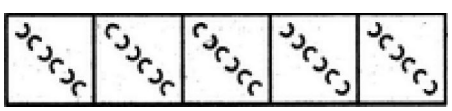
1.


Answer Figures

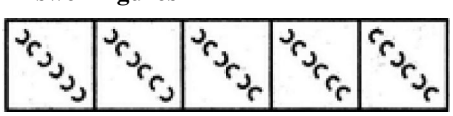


(*a*) (*b*) (*c*) (*d*) (*e*)

Problem Figures

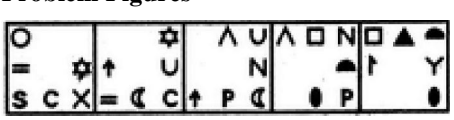
2.


Answer Figures

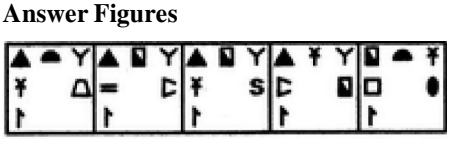


(*a*) (*b*) (*c*) (*d*) (*e*)

Problem Figures

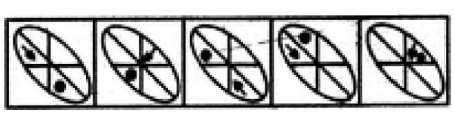
3.


Answer Figures

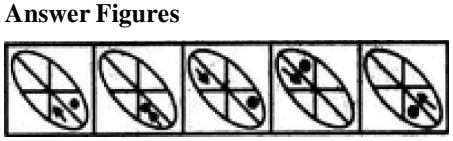


(*a*) (*b*) (*c*) (*d*) (*e*)

Problem Figures

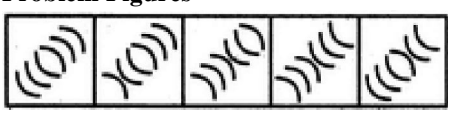
4.


Answer Figures

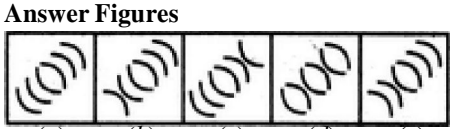


(*a*) (*b*) (*c*) (*d*) (*e*)

Problem Figures

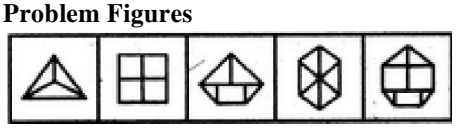
5.


Answer Figures

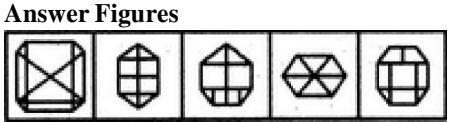


(*a*) (*b*) (*c*) (*d*) (*e*)

Problem Figures

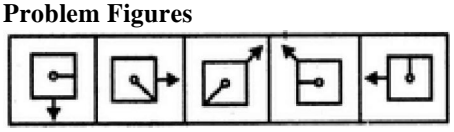
6.


Answer Figures

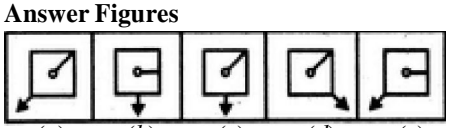


(*a*) (*b*) (*c*) (*d*) (*e*)

Problem Figures

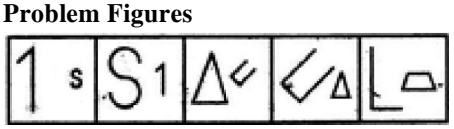
7.


Answer Figures

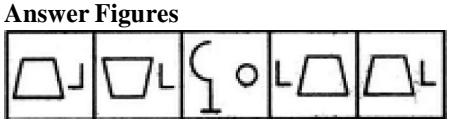


(*a*) (*b*) (*c*) (*d*) (*e*)

Problem Figures

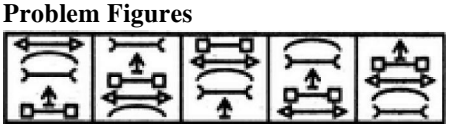
8.


Answer Figures

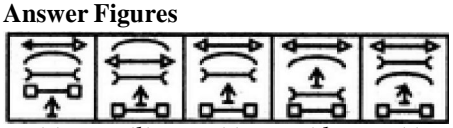


(*a*) (*b*) (*c*) (*d*) (*e*)

Problem Figures

9.


Answer Figures



(*a*) (*b*) (*c*) (*d*) (*e*)

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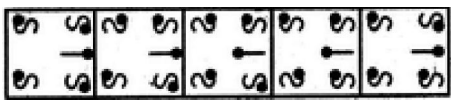
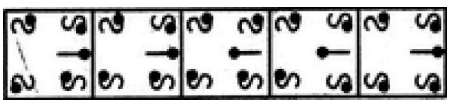
Problem Figures

10. 

Answer Figures



(*a*) (*b*) (*c*) (*d*) (*e*)

EXPLANATORY ANSWERS

1. (*d*) : In each step, all the elements move to the adjacent corner (of the square boundary) in a CW direction and the element that reaches the upper-left corner gets vertically inverted.

2. (*c*) : We can label the arcs as shown . The arcs get inverted in the sequence (1 & 2), (3, 4 & 5), (6 & 1), (2, 3 & 4), (5 & 6), ...

3. (*d*) : All the elements move half-a-side of the square boundary in ACW direction in each step. Also, first, third and fifth elements are replaced by new elements in one step and second, fourth and sixth elements are replaced by new elements in the next step. The two steps are repeated alternately.

4. (*a*) : In each step, the dot moves one space CW and the arrow moves two spaces CW.

5. (*c*) : One arc and four arcs get inverted alternately.

6. (*e*) : The number of parts increases by one along with the number of sides in the figure.

7. (*c*) : The pin rotates 45°CW and 90°CW alternately and moves one space (each space is equal to half-a-side of the square) and two spaces CW alternately. The arrow rotates 90°ACW and 45°ACW alternately and moves two spaces and one space.

8. (*e*) : In one step, the two elements interchange positions and the smaller element gets enlarged while the larger element gets reduced in size. In the next step, the smaller element is replaced by a new small element and the larger element is replaced by a new large element.

9. (*c*) : In each step, the elements move in the order .

10. (*b*) : The upper-left element gets laterally inverted in first, third, fifth. .... steps; the upper-right element gets rotated through 180° is first, fourth, seventh,.... steps; the lower-left element gets laterally inverted in second, fourth, sixth, ... steps; the lower-right element gets rotated through 180° in third, sixth,... steps and the pin at the middle-right position gets laterally inverted in every second step.

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CHAPTER 2

Semantic Classification

Classification means arranging the given content in groups or classes having qualities of same kind. In classification type questions, the figures or items are sorted out in groups on the basis of their similarities in qualities in shapes, size, pattern, structure, genus, order, species, grade, style, constituents and other specifications, and thus the answer is found out.

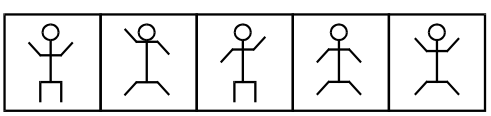
TYPE-I

Classification of this type does not have two sets of figures known as Problem Figures and Answer Figures; instead they have only one set of four or five figures known as Problem Figures. One of these Problem Figures is not like the other four figures. In other words, three or four of the Answer Figures belong to a class while one which is the odd figures, does not belong to it.

MULTIPLE CHOICE QUESTIONS

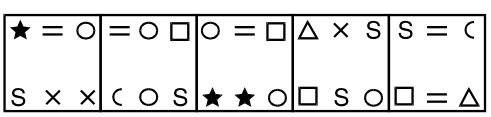
Directions : *In each of the following questions one of the figures is different from the rest. Spot the figure.*

1.



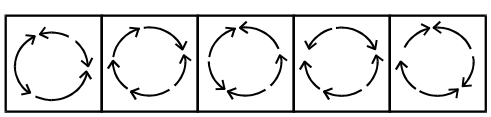
(*a*) (*b*) (*c*) (*d*) (*e*)

2.



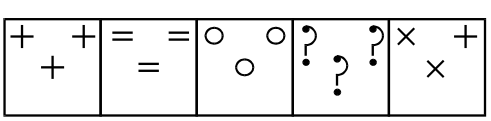
(*a*) (*b*) (*c*) (*d*) (*e*)

3.



(*a*) (*b*) (*c*) (*d*) (*e*)

4.



(*a*) (*b*) (*c*) (*d*) (*e*)

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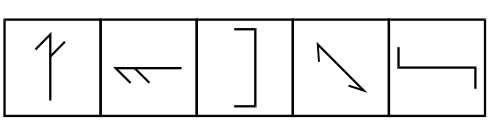

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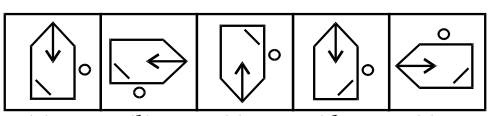

(*a*) (*b*) (*c*) (*d*) (*e*)

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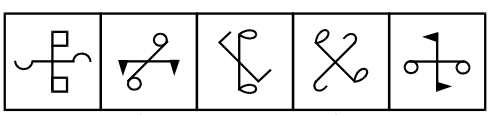

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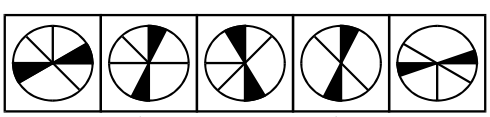
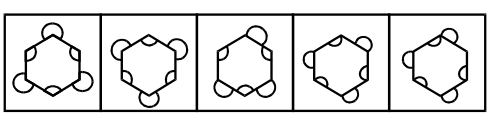
8.



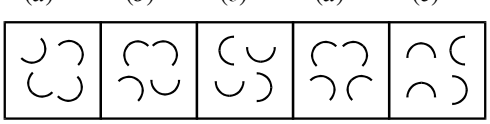
(*a*) (*b*) (*c*) (*d*) (*e*)

9.



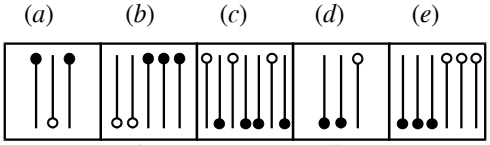
(*a*) (*b*) (*c*) (*d*) (*e*)

10.



(*a*) (*b*) (*c*) (*d*) (*e*)

11.



(*a*) (*b*) (*c*) (*d*) (*e*)

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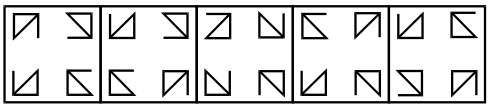
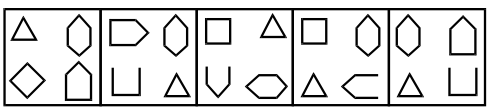
12.



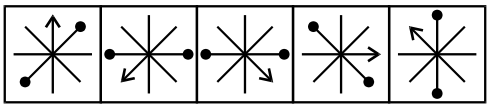
(*a*) (*b*) (*c*) (*d*) (*e*)

13.



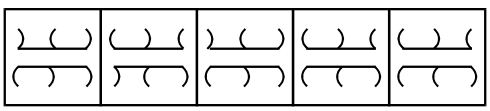
(*a*) (*b*) (*c*) (*d*) (*e*)

14.



(*a*) (*b*) (*c*) (*d*) (*e*)

15.



(*a*) (*b*) (*c*) (*d*) (*e*)

EXPLANATORY ANSWERS

1. (*d*) : Only in this figure all the lines making the hands and legs of the human shape are drawn downwards.

2. (*c*) : In all other figures only one set of elements is identical.

3. (*b*) : Only in this figure four arrows are pointing in same direction, and one arrow in its opposite direction. In other figures three arrows are in same direction and two in the opposite direction.

4. (*e*) : All other figures have three identical elements.

5. (*d*) : In all other figures two lines are parallelly drawn.

6. (*c*) : In all other figures the circle is on the left side of the arrow.

7. (*c*) : In all other figures one line has two elements on same side and the other line has two elements, one on either side. In this figure both the lines have two elements on same side.

8. (*d*) : Only in this figure one of the three sections in between the shaded sections is not marked.

9. (*e*) : In all other figures the elements inside as well as outside the hexagon are placed at equal distance. In this figure the outside element at the top is wrongly placed (It should be near the other corner of the same line).

10. (*d*) : In all other figures two elements are in same direction and the other two elements are opposite to each other.

11. (*e*) : Only in this figure the two types of elements are equal in number.

12. (*c*) : In all other figures the diagonal line in all other elements is drawn from the right end.

13. (*a*) : In all other figures one of the four elements has one open side.

14. (*c*) : In all other figures the arrow is to the left of the dot.

15. (*b*) : In all other figures two of the three curves on one of the lines are in the same direction and are adjacent.

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CHAPTER 3

Figural Analogy

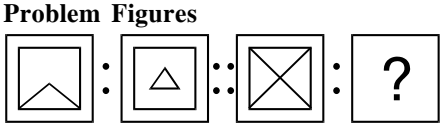
Figural Analogy is a process of reasoning between two parallel cases. It relates to agreement or correspondence in certain respects between two things. It is a process whereby the underlying relationship that exists between two figures, designs or patterns is determined. Under the process, one has to discover the features common to the two figures or designs. This common feature is a model or base. The question seeks solution on the basis of this model or base.

In non-verbal analogy questions, there are two sets of figures which are known as *(i)* Problem Figures, and *(ii)* Answer Figures. The Problem Figures are divided into two parts. The Answer Figures are given below the Problem Figures.

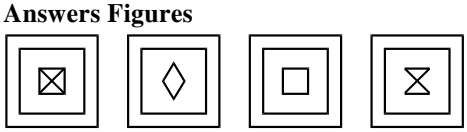
MULTIPLE CHOICE QUESTIONS

Directions : *The second figure in the first unit of the Problem Figures bears a certain relationship to the first figure. Similarly, one of the figures in the Answer Figures bears the same relationship to the first figure in the second unit of the Problem Figures. Locate the figure which would fit the question mark.*

1. Problem Figures

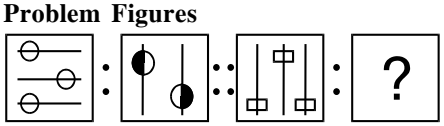


Answers Figures

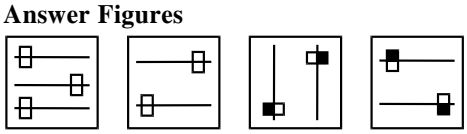


(*a*) (*b*) (*c*) (*d*)

2. Problem Figures

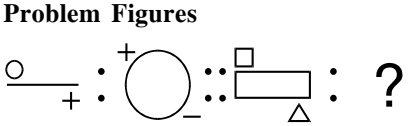


Answer Figures

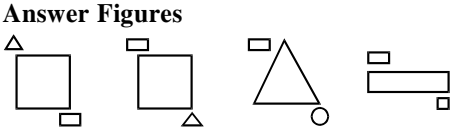


(*a*) (*b*) (*c*) (*d*)

3. Problem Figures

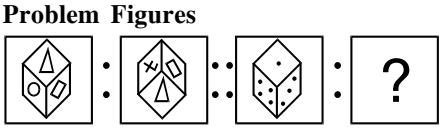


Answer Figures

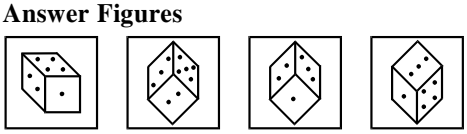


(*a*) (*b*) (*c*) (*d*)

4. Problem Figures

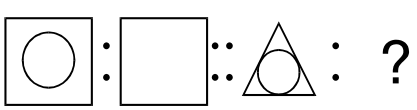


Answer Figures

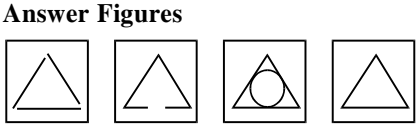


(*a*) (*b*) (*c*) (*d*)

5. Problem Figures



Answer Figures



(*a*) (*b*) (*c*) (*d*)

6. Problem Figures

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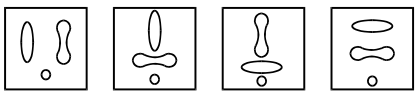
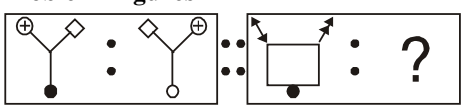
Answer Figures

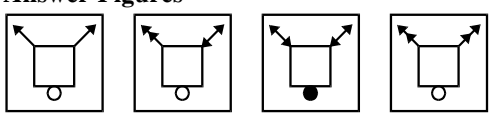


(*a*) (*b*) (*c*) (*d*)

7. Problem Figures

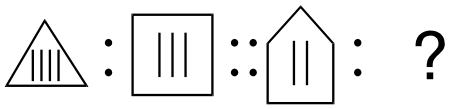


Answer Figures

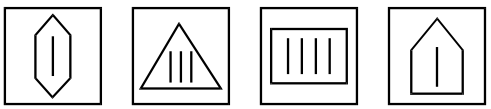


(*a*) (*b*) (*c*) (*d*)

8. Problem Figures

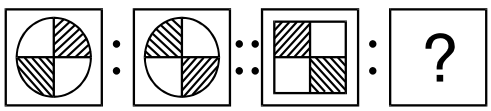


Answer Figures

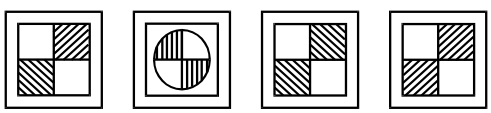


(*a*) (*b*) (*c*) (*d*)

9. Problem Figures



Answer Figures



(*a*) (*b*) (*c*) (*d*)

EXPLANATORY ANSWERS

1. (*d*) : The triangle in the first figure is moved to the centre of the second figure. Similarly, the two triangles joined at the apex are moved to the centre in answer figure.

2. (*d*) : The first figure is turned by 90° one of the bars is removed and opposite sides of the element attached to the bar are shaded to get the second figure.

3. (*a*) : The element at the bottom is moved to the diagonal corner, the element in the top is enlarged and moved to the centre and element in the middle is reduced and moved to the bottom right corner.

4. (*c*) : The view of the cube is changed from top to bottom. The design on the right side remains unchanged while the design on the left side is changed.

5. (*d*) : The inner shape in the first figure is removed to get the second figure.

6. (*b*) : The two half shapes placed vertically are turned upside down and joined, and this new shape is moved to the top. The two curved shapes placed horizontally are joined and this new shape is moved to the centre. One of the two remaining corner shapes is moved to the bottom.

7. (*b*) : The places of elements on the top are interchanged and the shade inside the circle is removed.

8. (*a*) : One of the vertical lines is removed and the number of lines making the second figure is increased by one.

9. (*a*) : First figure is rotated 90° anticlockwise to get the second figure.

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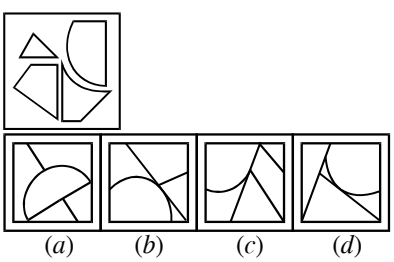
Spatial Visualization

In such questions, cut-out pieces are given alongwith the whole figure, that is the figure out of which the figures have been cut. By looking at the cut-out figures one has to find out the figure which may be constituted by putting the pieces together, i.e., one has to find out the figure of which the pieces have been cut. One has to be very imaginative and has to use space perception in finding out the solution. The whole process is mental and requires special skill in visualising different spatial patterns. It is not easy to develop this skill overnight but it can certainly be cultivated by practice and the method of trial and error.

MULTIPLE CHOICE QUESTIONS

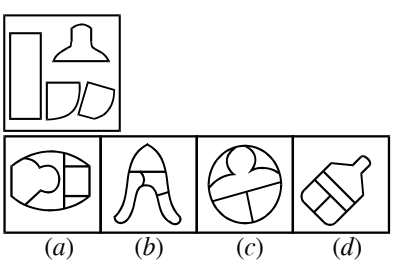
Directions (Qs. 1-5) : *Which one figure can be made out of given paper cut-outs?*

1.



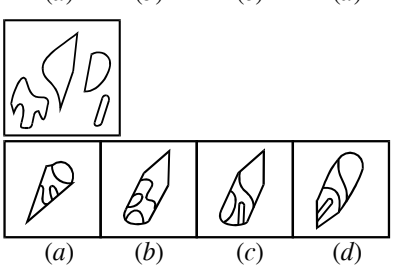
(*a*) (*b*) (*c*) (*d*)

2.



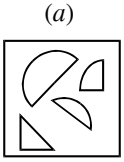
(*a*) (*b*) (*c*) (*d*)

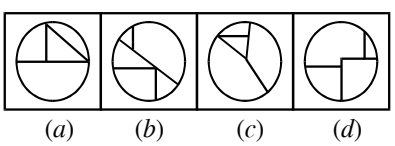
3.



(*a*) (*b*) (*c*) (*d*)

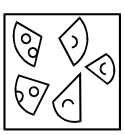
4.

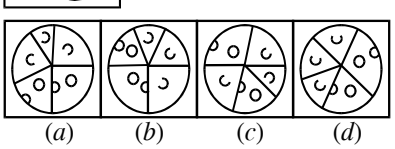




(*a*) (*b*) (*c*) (*d*)

5.

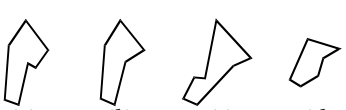




(*a*) (*b*) (*c*) (*d*)

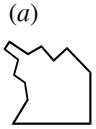
Direction (Qs. 6-10) : *In each of the following questions an irregular piece of paper has been cut into two pieces. One piece has been shown on the left while the other piece has been given as one of the four alternatives against it. Find the correct alternative:*

6.



(*a*) (*b*) (*c*) (*d*)

7.



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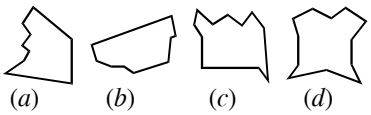
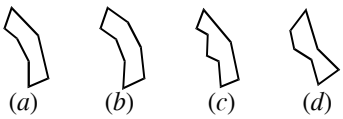


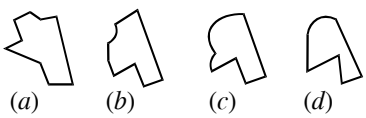
(*a*) (*b*) (*c*) (*d*)

8.

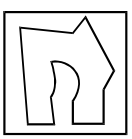


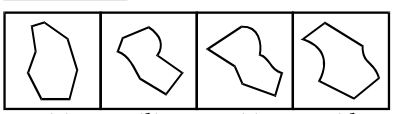
(*a*) (*b*) (*c*) (*d*)

9.



(*a*) (*b*) (*c*) (*d*)

10. 



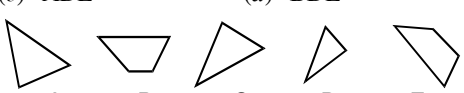
(*a*) (*b*) (*c*) (*d*)

Directions (Qs. 11-15) : *In each of the following questions five diagrams marked A to E are given. Three of these when put together form an equilateral triangle and have been given as one of the four alternatives under the question. Find the correct alternative in each case.*

11.

A B C D E

(*a*) ABE (*b*) BCE
(*c*) ADE (*d*) BDE

12. 

A B C D E

(*a*) ABC (*b*) BCD
(*c*) CDE (*d*) BDE

13.

A B C D E

(*a*) BCD (*b*) CDE
(*c*) ABD (*d*) ABE

14.

A B C D E

(*a*) ABD (*b*) ACD
(*c*) BDE (*d*) CDE

15.

A B C D E

(*a*) ABC (*b*) ACE
(*c*) BDE (*d*) CDE

Directions (Qs. 16-20) : *In each of the following questions five diagrams A, B, C, D and E have been given. Three of these diagrams make a complete square which have been given as one of the four alternatives under it. Find the correct alternative in each case.*

16.

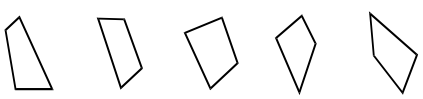
A B C D E

(*a*) ABC (*b*) BDE
(*c*) CDE (*d*) BCD

17.

A B C D E

(*a*) ACD (*b*) BDE
(*c*) BCE (*d*) CDE

18. 

A B C D E

(*a*) ACD (*b*) BCD
(*c*) ACE (*d*) CDE

19.

A B C D E

(*a*) ABC (*b*) ACE
(*c*) ADE (*d*) CDE

20.

A B C D E

(*a*) BDE (*b*) ABC
(*c*) ACD (*d*) BCD

ANSWERS

1	2	3	4	5	6	7	8	9	10
(*b*)	(*d*)	(*c*)	(*a*)	(*b*)	(*b*)	(*c*)	(*a*)	(*d*)	(*c*)
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
(*c*)	(*d*)	(*d*)	(*b*)	(*b*)	(*d*)	(*b*)	(*c*)	(*c*)	(*d*)

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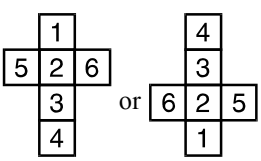
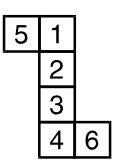
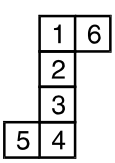
Space Visualization

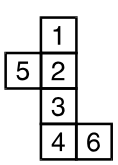
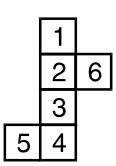
In these type of questions, a template or a layout of a cube, dice or a box is given, which can be folded to produce different patterns. To solve these questions what is required is a clear study of the given layout and the selection of one figure, from the alternative patterns which can be made from the given layout. To attempt such problems understand the unfolded patterns given below:

Layout 1.  or

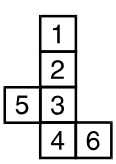
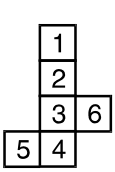
The opposite sides are :
1—3, 2 — 4 and 5 — 6

Layout 2.  or 

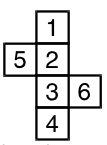
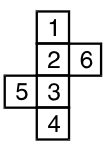
The opposite sides are :
1 — 3, 2 — 4 and 5 — 6

Layout 3.  or 

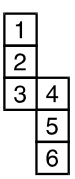
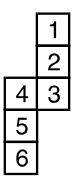
The opposite sides are :
1 — 3, 2 — 4 and 5 — 6.

Layout 4.  or 

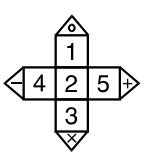
The opposite sides are :
1 — 3, 2 — 4 and 5 — 6

Layout 5.  or 

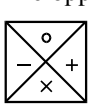
The opposite sides are :
1 — 3, 2 — 4 and 5 — 6

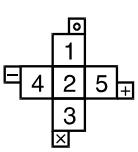
Layout 6.  or 

The opposite sides are :
1 — 3, 2 — 5 and 4 — 6

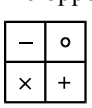
Layout 7. 

The opposite sides are :

 — 2, 1 — 3 and 4 — 5. Here, side 6 is divided into four parts

Layout 8. 

The opposite sides are

 — 2, 1 — 3 and 4 — 5. Here, side 6 is divided into four parts.

Observe from the above layouts that all sides except the opposite side are adjacent sides. Also keep in mind that the three visible sides of the option figures are one of the opposite sides of each opposite pair.

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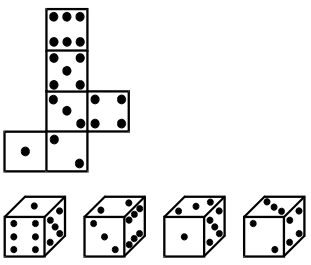
MULTIPLE CHOICE QUESTIONS

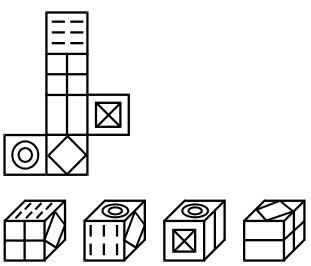
Directions : *The figure is folded to produce different box patterns. Study the pattern to know if they can be produced from given figure and select the answer from the alternatives.*

1.



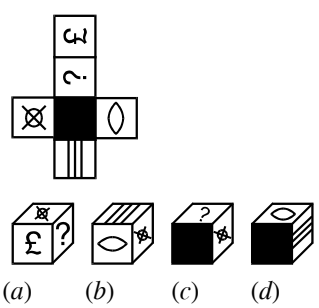
(*a*) (*b*) (*c*) (*d*)

2.



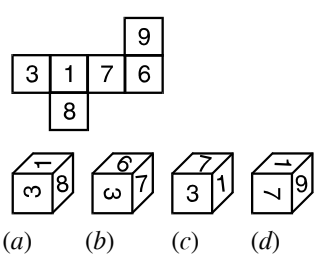
(*a*) (*b*) (*c*) (*d*)

3.



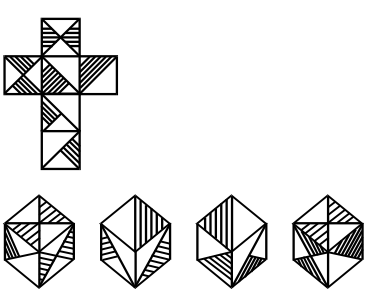
(*a*) (*b*) (*c*) (*d*)

4.



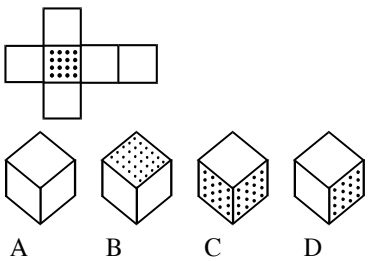
(*a*) (*b*) (*c*) (*d*)

5.



(*a*) (*b*) (*c*) (*d*)

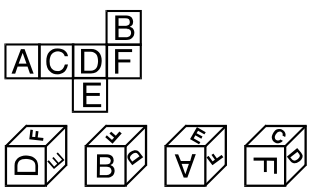
6.



A B C D

(*a*) A, B and D (*b*) B and D
(*c*) B, C and D (*d*) A and D

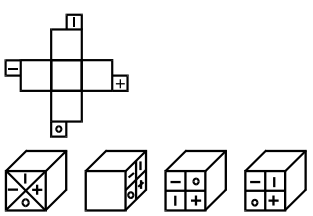
7.



A B C D

(*a*) A and B (*b*) A and D
(*c*) B and C (*d*) All four

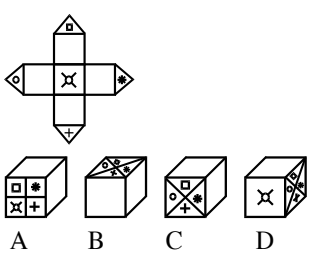
8.



A B C D

(*a*) B and D (*b*) A and D
(*c*) B and C (*d*) C and D

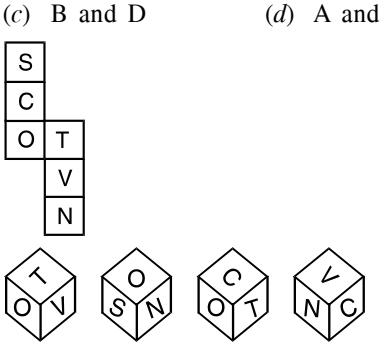
9.



A B C D

(*a*) A and C (*b*) B and C
(*c*) B and D (*d*) A and D

10.



A B C D

(*a*) B and C (*b*) A and D
(*c*) A and C (*d*) All four

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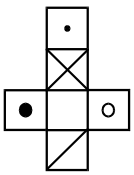
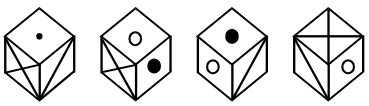
11.



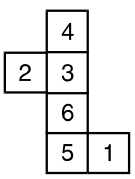


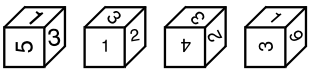
A B C D

(*a*) A and D (*b*) B, C and D

(*c*) All four (*d*) None of the above

12.



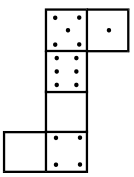


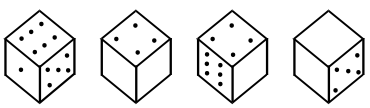
A B C D

(*a*) A and C (*b*) C and D

(*c*) B and C (*d*) B and D

13.





A B C D

(*a*) A and C (*b*) A and B

(*c*) B and C (*d*) B and D

EXPLANATORY ANSWERS

(All answers are based on number pattern of the sides as in the layout given in the beginning of this section)

1. (*d*) : The given figure is same as layout 4. The sides adjacent to top side 3 are in order 2, 5, 4, 6 — of these sides, 4 and 6 are seen on left and right sides respectively.

2. (*b*) : The given figure is same as layout 4. The sides adjacent to top side 5 are in order 4, 3, 2, 1 —of these sides 1 and 4 are seen on left and right sides respectively.

3. (*d*) : The given figure is same as layout 1. The sides adjacent to top side 5 are in order 4, 3, 2, 1 — of these sides 2 and 1 are seen on left and right sides respectively.

4. (*a*) : The given figure is same as layout 3. The sides adjacent to top side 2 are in order 1, 5, 3, 6 — of these sides 1 and 5 are seen on left and right sides respectively.

5. (*c*) : The given figure is same as layout 1. The sides adjacent to top side 6 are in order 1, 2, 3, 4 — of these sides 2 and 3 are seen on left and right sides respectively.

6. (*a*) : The given figure is same as layout 1. The top, left and right sides in figure option (a) are 1, 4 and 5 respectively (other combinations of sides for this figure are also possible); in figure option (b) 2, 1 and 5 respectively (other combination of sides for this figure are also possible; and in figure option (d) 1, 5 and 2 respectively (other combinations of sides for this figure are also possible).

7. (*a*) : The given figure is same as layout 4. In option figure (a) the top side 4 has side 3 on left and side 5 on right. In option figure (b) the top side 4 has side 6 on its left and side 3 on right.

Note : in option figure (c) the sides are correct but the printing of letter on right side is incorrect.

8. (*a*) : The given figure is same as layout 8. Option figures (b) and (d) contain the correct joints of side 6.

9. (*b*) : The given figure is same as layout 7. Option figures (a) and (c) contain the correct joints of side 6.

10. (*c*) : The given figure is same as layout 6. In option figure (a) the top side 4 has side 3 on left and side 5 on right. In option figure (c) the top side 2 has side 3 on left and side 4 on right.

11. (*d*) : The given figure is same as layout 1. None of the figure options can be made from the given figure.

12. (*b*) : The given figure is same as layout 3. In option figure (c) the top side 2 has side 1 on left and side 5 on right. In option figure (d) the top side 6 has side 2 on left and side 3 on right.

13. (*b*) : The given figure is same as layout 2. In option figure (a) the top side 2 has side 6 on left and side 1 on right. In option figure (b) the top side 4 has side 3 on left and side 5 on right.

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CHAPTER 6

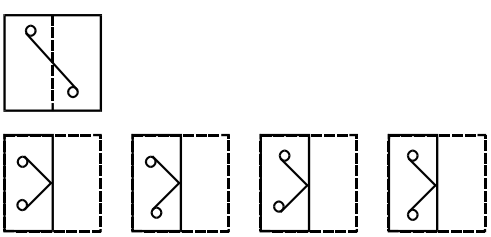
Pinch Hole/Paper Folding & Unfolding

These type of questions are based on a piece of paper which is folded and cut or punched in a particular manner. One of the option figures either resembles the pattern that would be formed when the paper is unfolded or resembles the form in which the paper is folded and cut or punched.

MULTIPLE CHOICE QUESTIONS

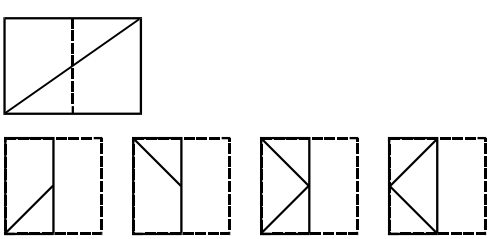
Directions (Qs. 1-5) : *In each one of the following problems, a square transparent sheet with a pattern is given. Figure out from amongst the four alternatives as to how the pattern would appear when the transparent sheet is folded at the dotted line.*

1.



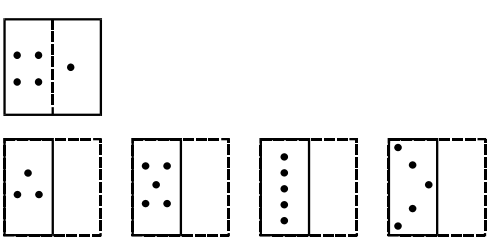
(*a*) (*b*) (*c*) (*d*)

2.



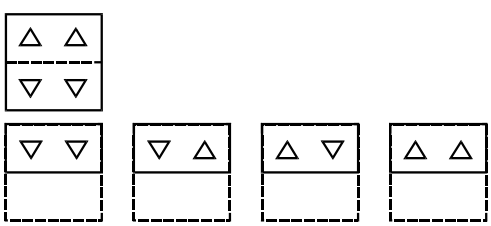
(*a*) (*b*) (*c*) (*d*)

3.



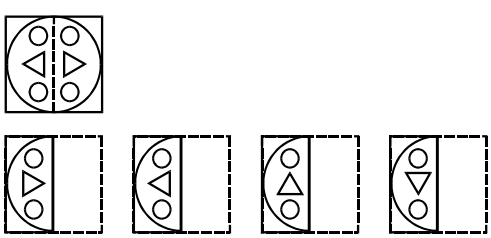
(*a*) (*b*) (*c*) (*d*)

4.



(*a*) (*b*) (*c*) (*d*)

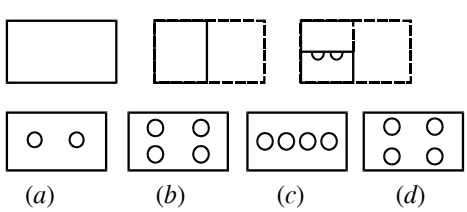
5.



(*a*) (*b*) (*c*) (*d*)

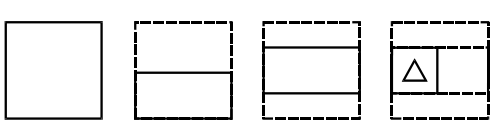
Directions (Qs. 6-13) : *In each of the following questions a piece of paper has been folded and then punched. From the given options figure out the correct response which shows how it will appear when opened.*

6.



(*a*) (*b*) (*c*) (*d*)

7.



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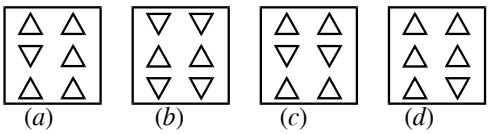
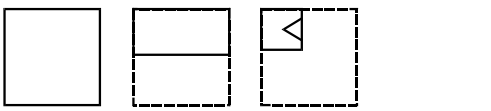


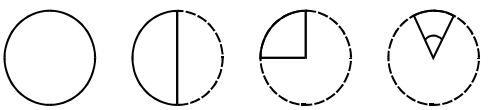
(*a*) (*b*) (*c*) (*d*)

8.



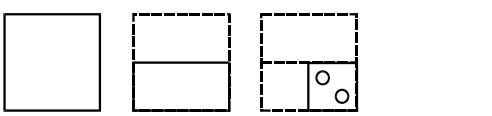
(*a*) (*b*) (*c*) (*d*)

9.



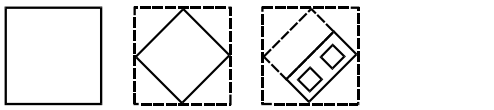
(*a*) (*b*) (*c*) (*d*)

10.



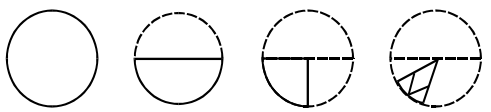
(*a*) (*b*) (*c*) (*d*)

11.



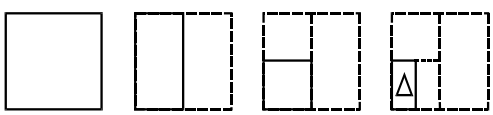
(*a*) (*b*) (*c*) (*d*)

12.



(*a*) (*b*) (*c*) (*d*)

13.

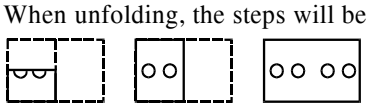


(*a*) (*b*) (*c*) (*d*)

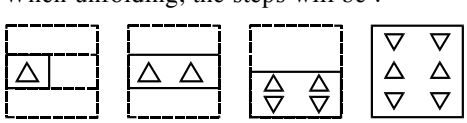
EXPLANATORY ANSWERS

1. (*d*) **2.** (*c*)
3. (*b*) **4.** (*d*)
5. (*b*)

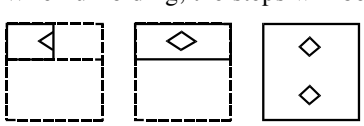
6. (*c*) : When unfolding, the steps will be :



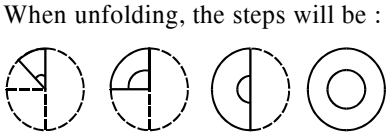
7. (*b*) : When unfolding, the steps will be :



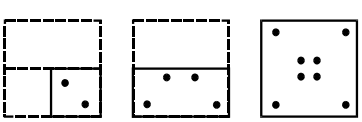
8. (*d*) : When unfolding, the steps will be :



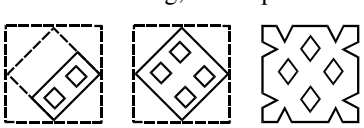
9. (*c*) : When unfolding, the steps will be :



10. (*a*) : When unfolding, the steps will be :

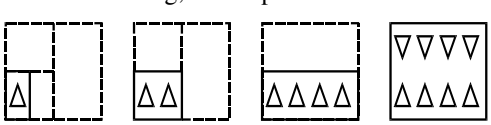


11. (*d*) : When unfolding, the steps will be :



12. (*a*) : When unfolding, the steps will be :

13. (*b*) : When unfolding, the steps will be :



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Figural Pattern Folding and Completion

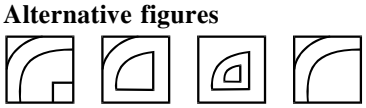
In these type of questions an incomplete figure pattern is given followed by alternative figures of which one will complete the given figure pattern. These figure patterns are mainly based on symmetries.

MULTIPLE CHOICE QUESTIONS

Directions : *In each question, which one of the alternative figures will complete the given figure pattern?*

1. Pattern

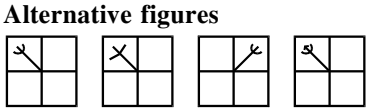
Alternative figures



(*a*) (*b*) (*c*) (*d*)

2. Pattern

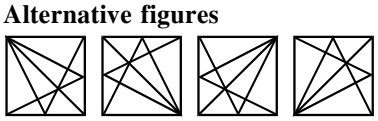
Alternative figures



(*a*) (*b*) (*c*) (*d*)

3. Pattern

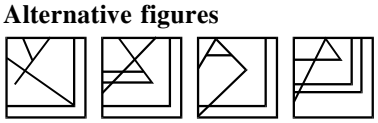
Alternative figures



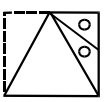
(*a*) (*b*) (*c*) (*d*)

4. Pattern

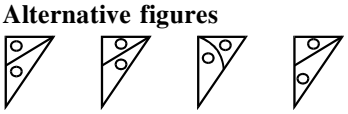
Alternative figures



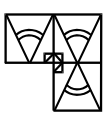
(*a*) (*b*) (*c*) (*d*)

5. Pattern 

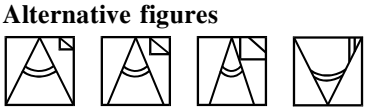
Alternative figures



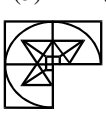
(*a*) (*b*) (*c*) (*d*)

6. Pattern 

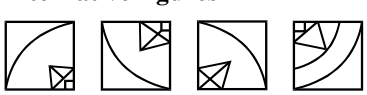
Alternative figures



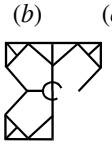
(*a*) (*b*) (*c*) (*d*)

7. Pattern 

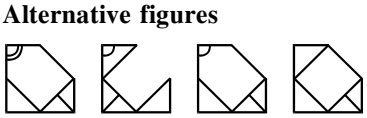
Alternative figures



(*a*) (*b*) (*c*) (*d*)

8. Pattern 

Alternative figures



(*a*) (*b*) (*c*) (*d*)

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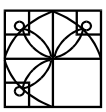
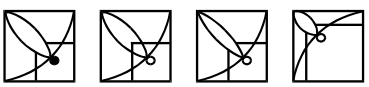
9. Pattern

Alternative figures

(*a*) (*b*) (*c*) (*d*)

10. Pattern 

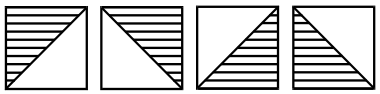
Alternative figures



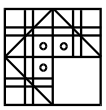
(*a*) (*b*) (*c*) (*d*)

11. Pattern

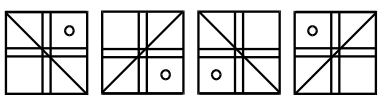
Alternative figures



(*a*) (*b*) (*c*) (*d*)

12. Pattern 

Alternative figures

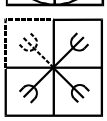


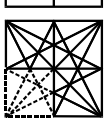
(*a*) (*b*) (*c*) (*d*)

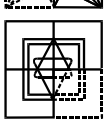
EXPLANATORY ANSWERS

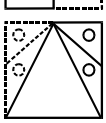
All the completed figures will look like this:

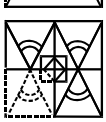
1. (*b*) :

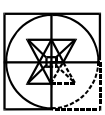
2. (*a*) : 

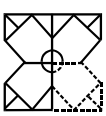
3. (*d*) : 

4. (*d*) : 

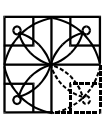
5. (*a*) : 

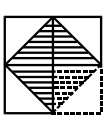
6. (*a*) : 

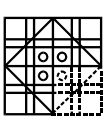
7. (*b*) : 

8. (*c*) : 

9. (*a*) :

10. (*b*) : 

11. (*a*) : 

12. (*d*) : 

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Visual Memory

These type of problems are based on the mirror images or reflections of number, letters and figures. While attempting such questions one must be able to visualise clearly the questioned reflections, be they on vertical plane or on horizontal plane. Study the chart and information given below. The visualisation of letters and numbers is easier than the visualisation of figures for the simple reason that the figures have many forms and all cannot be summed up.

Horizontal Mirror Images (HMI) of Numbers

Number	*HMI*	*Number*	*HMI*
0	0	5	ƨ
1	ı	6	ϭ
2	ƨ	7	⊥
3	ε	8	8
4	↊	9	ϱ

Note : HMI of 0 and 8 remain unchanged

Vertical Mirror Images (VMI) of Numbers

Numbers :	0	1	2	3	4	5	6	7	8	9
VMI :	0	ı	ᔭ	ε	↊	ƨ	ϱ	⊥	8	ϭ

Note : VMI of 0, 3 and 8 remain unchanged.

Exceptions in style need caution. Example 3 will be ε, or 8 will be 8.

Horizontal Mirror Images of Capital Letters

Letter	HMI	Letter	HMI	H letter	HMI
A	A	J	ſ	S	Ƨ
B	B	K	ꓘ	T	T
C	Ↄ	L	⅃	U	U
D	ᗡ	M	M	V	V
E	Ǝ	N	И	W	W
F	ꟻ	O	O	X	X
G	⅁	P	ꟼ	Y	Y
H	H	Q	Ọ	Z	Z
I	I	R	Я		

Note : HMI of A, H, I, M, O, T, U, V, W, X and Y remain unchanged.

Exceptions in style need caution. Example : A will be ⱯA, or X will be ⵅX.

Vertical Mirror Images of Capital Letters

Letters :	A	B	C	D	E	F	G	H	I	J	K	L	M
VMI :	∀	B	Ↄ	D	Ǝ	Ⅎ	⅁	H	I	ſ	ꓘ	⅂	W

Letters :	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
VMI :	И	O	ꟼ	Ọ	Я	Ƨ	⊥	∩	Λ	M	X	⅄	Z

Note : VMI of C, D, E, H, I, K, O and X remain unchanged.

Horizontal Mirror Images of Small Letters

Letter	HMI	Letter	HMI	Letter	HMI
a	ɐ	j	ɾ	s	ƨ
b	d	k	ʞ	t	ɟ
c	ɔ	l	l	u	n
d	b	m	ɯ	v	v
e	ǝ	n	u	w	w
f	ɟ	o	o	x	x
g	ƃ	p	q	y	ʏ
h	ɥ	q	p	z	z
i	ı	r	ɹ		

Note : HMI of o, v, w and x remain unchanged.

Vertical Mirror Images of Small Letters

Letter :	a	b	c	d	e	f	g	h	i	j	k	l	m
VMI :	ɒ	d	ɔ	b	ɘ	ꞇ	ϱ	ɥ	ı	ɾ	ʞ	l	ɯ

Letter :	n	o	p	q	r	s	t	u	v	w	x	y	z
VMI :	u	o	d	b	ɹ	ƨ	ɟ	n	ʌ	w	x	ʏ	z

Note : VMI of c, o and x remain unchanged. Letter 1 has exceptions: if it is a straight vertical line – 1 then it remains unchanged.

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MULTIPLE CHOICE QUESTIONS

Directions (Qs. 1 to 15) : *In each question below which is the exact horizontal mirror image?*

1. DuST
(a) ꓶSuᗡ (b) ⊥Snᗡ
(c) ⊥Suᗡ (d) ᗡuSꓶ

2. CHAIR
(a) ЯIHAↃ (b) ЯIAHↃ
(c) ЯIAHC (d) ↃHAIЯ

3. WHOM
(a) MOHW (b) WOHM
(c) ꟽHOꟽ (d) ꟽOHꟽ

4. plaque
(a) ǝupɐlq (b) ǝuqblp
(c) qlapue (d) ǝlɐpnǝ

5. brows
(a) ɹowsd (b) drows
(c) ʍoɹd (d) ʍord

6. flying
(a) ꞵuiʎlɟ (b) ꞵuilʎɟ
(c) ꞵuiʎlɟ (d) ꞵuiʎlɟ

7. 4379
(a) ϱ7Ɛ4 (b) ϱƐ7ㄣ
(c) ϱ7ㄣ4 (d) 9Ɛ7ㄣ

8. 57182
(a) Ƨ8ㄎƧ (b) Ƨ8ㄎƧ
(c) Ƨ8ㄎƧ (d) Ƨ8ㄎ5

9. 69430
(a) 0ϱ4ϱ (b) 0ϱ4ϱ
(c) 0ㄣ4ϱ (d) 0ϱ4ϱ

10. 2JKS
(a) Ƨ⅂ㄎƧ (b) Ƨㄎ⅂Ƨ
(c) Ƨ⅂ㄎƧ (d) Ƨㄎ⅂2

11. P9Yf3
(a) ƐfYϱP (b) ƐfYϱ9
(c) Ɛ9Yϱ9 (d) Ɛ9Yϱ9

12. GZ5QRh
(a) hЯQƧZG (b) ɥЯQƧZG
(c) hЯQƧZG (d) hЯQ5ZG

13. 2$%CH
(a) HC%Ƨ2 (b) HC℅Ƨ2
(c) HↃ℅Ƨ2 (d) HC℅Ƨ2

14. 7↑FN8
(a) 8ИꟻF↑7 (b) 8NꟻF↑7
(c) 8ИF↑7 (d) 8NF↑7

15. yk19G
(a) Ꭾ9I⅄ʎ (b) Ꭾ9I⅄ʎ
(c) Ꭾ9I⅄ʎ (d) Ꭾ9I⅄ʎ

ANSWERS

1	2	3	4	5	6	7	8	9	10
(c)	(b)	(a)	(a)	(c)	(d)	(b)	(a)	(d)	(c)

11	12	13	14	15
(d)	(b)	(c)	(a)	(d)

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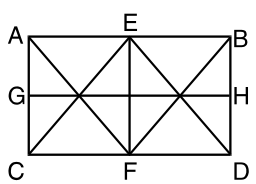
CHAPTER 9

Discrimination

In these problems one has to count the geometrical figures in a given complex figure. A little bit of systematic approach is needed to get the correct number of the asked figure. The shapes of all geometrical figures must be clear in mind.

SOLVED EXAMPLES

1. How many straight lines are used to make the figure given below?



(*a*) 8 (*b*) 6
(*c*) 10 (*d*) 12

Answer (*c*) : The method of counting is given below.

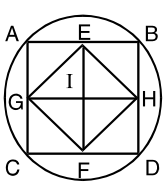
The horizontal lines are AB, GH and CD i.e. – 3 lines, the vertical lines are AC, EF and BD i.e. – 3 lines, the diagonal lines are CE, FB, AF and ED i.e. – 4 lines, therefore the total number of straight lines is

3 + 3 + 4 = 10

2. How many square are there is this figure?

(*a*) 4 (*b*) 6
(*c*) 8 (*d*) 5

Answer (*b*) : The squares are counted in this manner.



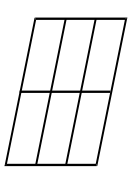
There is one main square ABCD divided into four parts by lines EF and GH. So, all the 5 squares are ABCD, AEGI, GICF, EBIH and IHFD. The square in the middle is EGHF. The total number of squares are 5 + 1 = 6

MULTIPLE CHOICE QUESTIONS

1. How many triangles are there in the figure given below?

(*a*) 24 (*b*) 27
(*c*) 25 (*d*) 26

2. How many parallelograms are there in this figure?



(*a*) 9 (*b*) 13
(*c*) 15 (*d*) 18

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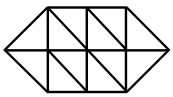
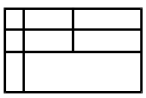
3. How many triangles are there in this figure?



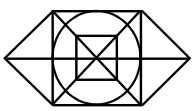
(*a*) 16 (*b*) 17
(*c*) 18 (*d*) 19

4. The number of rectangles in this figure are.



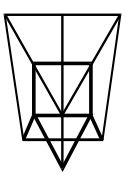
(*a*) 21 (*b*) 24
(*c*) 23 (*d*) 25

5. How many squares are hidden in this figure?



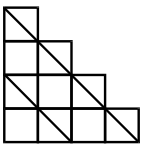
(*a*) 7 (*b*) 8
(*c*) 9 (*d*) 10

6. The number of triangles in this figure are.



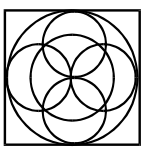
(*a*) 19 (*b*) 16
(*c*) 21 (*d*) 15

7. How many squares are there in the figure given below?



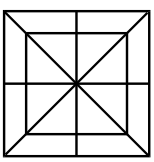
(*a*) 10 (*b*) 11
(*c*) 13 (*d*) 14

8. The number of circles in this figure is



(*a*) 6 (*b*) 5
(*c*) 2 (*d*) 3

9. How many triangles are there in the figure given below?

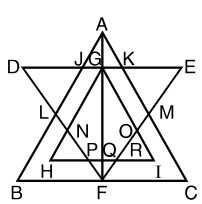


(*a*) 28 (*b*) 36
(*c*) 24 (*d*) 32

10. How many straight lines are needed to draw the figure in question 9?
(*a*) 10 (*b*) 12
(*c*) 11 (*d*) 13

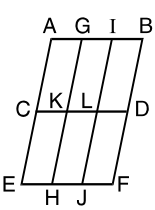
EXPLANATORY ANSWERS

1. (*a*) :



- The main triangles making the figure are ABC, DEF and GHI *i.e.,* – 3 triangles
- The simplest triangles are AJG, AGK, KEM, DJL, NHP, PQF, QFR and ORI *i.e.,* – 8 triangles
- The triangles formed by the bisecting line AF are ABF, AFC, GHQ, GQI, DGF and GFE *i.e.,* – 6 triangles
- The triangles formed inbetween the three triangles AJK, ALF, AMF, DGN, DGF, LBF, MFC, GEO, GNF and GOF – *i.e.,* 10 triangles
- So, the total number of triangles is
  3 + 8 + 6 + 10 = 27

2. (*d*) :



- The main parallelogram is ABEF *i.e.,* 1 parallelogram
- When divided into half by line CD the main figure has ABCD and CDEF *i.e.,* 2 parallelograms
- When further lines GH and IJ are drawn, the parallelograms are AGEH, GIJH and IBJF *i.e.,* – 3 parallelograms.
- The simplest parallelogram are AGCK, CKEH, GIKL, KLHJ, IBLD and LDJF *i.e.* – 6 parallelograms
  Other parallelograms are AICL, CLEJ, GBKD, KDHF, AIEJ and GBHF – *i.e.,* 6 parallelograms
  So, the total number of parallelograms is
  1 + 2 + 3 + 6 + 6 = 18

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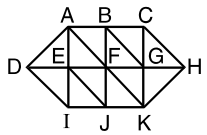
3. (*a*) : 

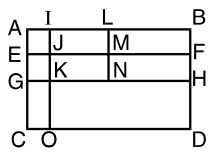
The simplest triangles are ADE, DEI, AEF, ABF, EIJ, EFJ, BFG, BCG, FJK, FGK, CGH and GHK – *i.e.,* – 12 triangles

The bisected triangles are ADI and CHK – *i.e.* – 2 triangles

Other triangles are AIK and ACK *i.e.,* – 2 triangles

So, the total number of triangles is

12 + 2 + 2 = 16

4. (*c*) : 

The main rectangle is ABCD – *i.e.,* – 1 rectangle

The simplest rectangles are AIEJ, ILJM, LBMF, EJGK, JMKN, MFNH, GKCO and KHOD *i.e.* – 8 rectangles.

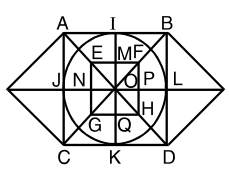
The rectangles which have two parts are ALEM, IBJF, EMGN, JFKH, AIGK, IKLN, LBNH, EJCO and GHCD *i.e.* – 9 rectangles.

The rectangles which have three parts are AICO, ABEF and EFGH *i.e.* – 3 rectangles

The rectangles which have four parts are ALGN and IBKH *i.e.* – 2 rectangles

So, the total number of rectangles

1 + 8 + 9 + 3 + 2 = 23

5. (*d*) : 

The main squares are ABCD and EFGH *i.e.,* – 2 squares

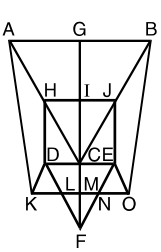
The simplest outer squares are AIJO, IBOL, JOCK and OLKD *i.e.,* – 4 squares

The simplest inner square are EMNO, NOGQ, MFOP and OPQH *i.e.,* – 4 squares

There are no other squares formed in the figure

So, the total number of squares is

2 + 4 + 4 = 10

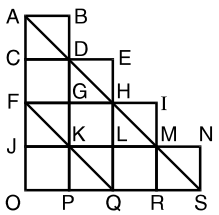
6. (*b*) : 

The main triangles are : ABC, DEF, LNF, and HJC *i.e.* 4 triangles

The simplest triangles are : HIC, IJC, HDC, JCE, DKL, LMF, MFN and NOE *i.e.* – 8 triangles

Other triangles are : AGC, GBC, DCF and CEF – *i.e.* 4 triangles

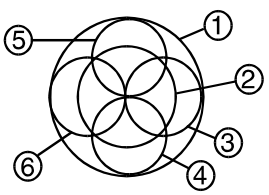
So, the total number of triangles is 4 + 8 + 4 = 16

7. (*c*) : 

The simplest squares are : ABCD, CDFG, DEGH, FGJK, GHKL, HILM, JKOP, KLPQ, LMQR and MNRS *i.e.* – 10 squares.

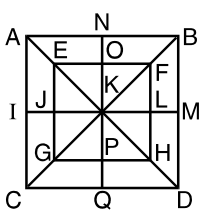
Other squares are : CEJL, FHOQ and GIPR *i.e.* – 3 squares

So, the total number of squares is 10 + 3 = 13

8. (*a*) : 

There are two main circles and four smaller circles intersecting each other.

So, the total number of circles is 2 + 4 = 6

9. (*d*) : 

The larger triangles are : ABC, BCD, ABD and ACD *i.e.* – 4 triangles

The smaller triangles are : EFH, EGH, EFG and FGH *i.e.* – 4 triangles.

The simplest triangles are : EJK, EOK, OFK, JKG, FKL, KLH, KGP and KPH *i.e.* – 8 triangles

The bisected triangles are: AKC, ABK, CKD, KBD, EKG, EKF, KHG, KHF, i.e., –8 triangle.

Other triangles are : ANK, NKB, KBM, KMD, KQD, KQC, KCI, IKA *i.e.* – 8 triangles.

So, the total number of triangles is

4 + 4 + 8 + 8 + 8 = 32

10. (*b*) : The horizontal lines are : AB, EF, KL, GH and CD *i.e.* – 5 lines.

The vertical lines are AC, EG, IJ, FH and BD *i.e.* – 5 lines.

The diagonal lines are : AD and BC *i.e.* – 2 lines.

So, the total number of lines used to draw this figure is 5 + 5 + 2 = 12

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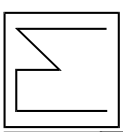
CHAPTER 10

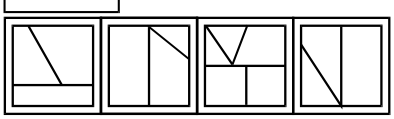
Embedded Figures

In these type of questions a figure form is given followed by alternative figures. In one of these figure options the given form is embedded. Practice of visualisation comes handy in attempting such easy questions.

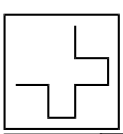
MULTIPLE CHOICE QUESTIONS

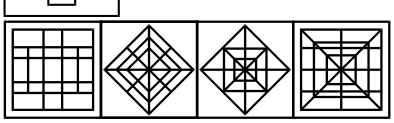
Directions (Qs. 1 to 6) : *In the questions given below a figure is given. From the given alternatives select the one in which the given figure is embedded.*

1. 

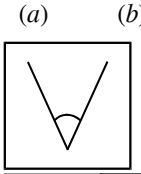


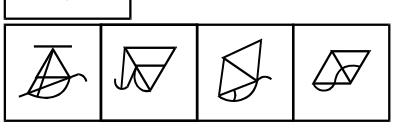
(*a*) (*b*) (*c*) (*d*)

2. 

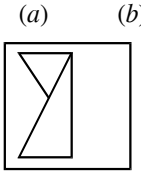


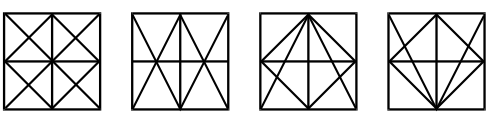
(*a*) (*b*) (*c*) (*d*)

3. 

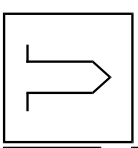


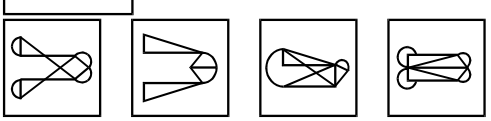
(*a*) (*b*) (*c*) (*d*)

4. 

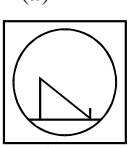


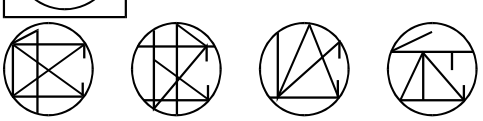
(*a*) (*b*) (*c*) (*d*)

5. 



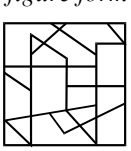
(*a*) (*b*) (*c*) (*d*)

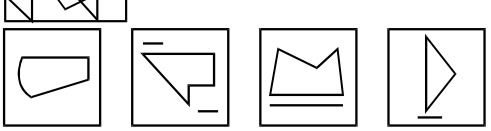
6. 



(*a*) (*b*) (*c*) (*d*)

Directions (Qs. 7 to 10) : *In each question given below find the figure form which is embedded in the given pattern.*

7. 



(*a*) (*b*) (*c*) (*d*)

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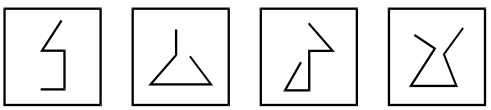
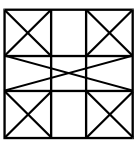
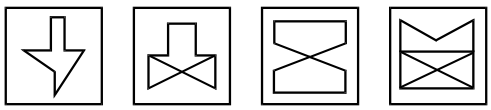
8.



(*a*) (*b*) (*c*) (*d*)

9. 



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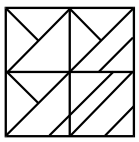
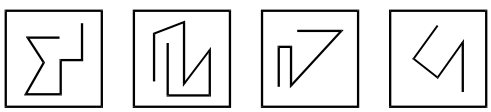
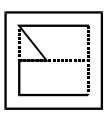
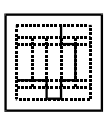
10. 

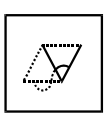


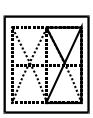
(*a*) (*b*) (*c*) (*d*)

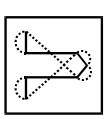
EXPLANATORY ANSWERS

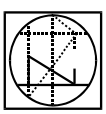
1. (*a*) : 

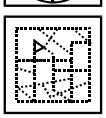
2. (*a*) : 

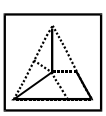
3. (*d*) : 

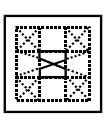
4. (*b*) : 

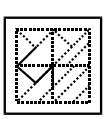
5. (*a*) : 

6. (*b*) : 

7. (*d*) : 

8. (*b*) : 

9. (*c*) : 

10. (*d*) : 

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NUMERICAL ABILITY

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Numbers System

Whole Numbers

In our System of numeration, numbers are written by using the symbols 0, 1, 2, 3, 4, 5, 6, 7, 8 and 9 with each symbol getting a value depending on the place it occupies. These symbols are called digits. A number related to the objects in a collection gives an idea of how many objects are there in the collection.

The number 789345126 can be represented as:

Ten crores	Crores	Ten Lacs (Millions)	Lacs	Ten Thousands	Thousands	Hundreds	Tens	Units
10^8	10^7	10^6	10^5	10^4	10^3	10^2	10^1	10^0
7	8	9	3	4	5	1	2	6

This number can be read as: "Seventy-eight crores, ninety-three lacs, forty-five thousands, one hundred twenty six".

1. **Natural Numbers or Positive Integers (N = 1, 2, 3, 4, 5 .....):** These are also called counting numbers. When two natural numbers are added or multiplied together, the result is always a natural number. Therefore, all positive integers, used for counting objects, are always **natural numbers** whereas zero together with negative integers and fractional numbers are not natural numbers.
2. **Whole Numbers: (W = 0, 1, 2, 3, 4, 5, ...):** The number '0' together with the natural numbers gives us the numbers which are called **whole numbers,** e.g., 0, 1, 2, 3, 4 ..... etc. whereas –10, –15, –12 ..... or $\frac{1}{5}, \frac{2}{9}, \frac{4}{5}$..... etc. are not whole numbers.
3. **Integers: (I = ..., –5, –4, –3, –2, –1, 0, 1, 2, 3, 4, 5, ...):** The negative numbers together with the whole numbers are called integers. The numbers –1, –2, –3, –4, –5, ... are called negative integers and 1, 2, 3, 4, 5, ..., *i.e.,* natural numbers are called positive integers. The number 0 is simply an integer, *i.e.,* it is neither positive nor negative.
4. **Rational Numbers:** A rational number is a number that can be put in the form $\frac{p}{q}$ where p and q are both integers and $q \neq 0$, e.g., 8, $-\frac{7}{5}$, $-\frac{3}{4}$, $\frac{1}{7}$, 0 .... are all rational numbers i.e. a rational number may be positive, zero or negative.
5. **Irrational Numbers:** An irrational number is a number that can not be put in the form $\frac{p}{q}$ where p and q are both integers and $q \neq 0$, e.g., $\sqrt{5}, \sqrt{11}, \sqrt{15}$, $3 + \sqrt{5}$ .... etc. are all irrational numbers.
6. **Real Numbers:** All those numbers which are either rational or irrational, are called real numbers, e.g., $\frac{11}{17}$, $\frac{19}{21}$, $-\frac{7}{8}$, $\sqrt{7}$, $8 + \sqrt{3}$ etc. are real numbers.
7. **Even Numbers:** All those numbers which are exactly divisible by 2, are called 'even numbers', e.g., 2, 8, 14, 28, 52 etc. are even numbers.
8. **Odd Numbers:** All those numbers which are not exactly divisible by 2, are called 'odd numbers', e.g., 1, 3, 5, 7, 9, 19 etc. are odd numbers.

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9. **Composite Numbers:** The numbers which are divisible not only by 1 or themselves, but by some other numbers also, are called the 'composite numbers'. In other words, the numbers which have more than two factors are called 'composite numbers.', e.g., 4, 9, 15, 18, 27, ... etc. are composite numbers.
10. **Prime Numbers:** The numbers which have only two factors, 1 and the number itself are called 'prime numbers', e.g., 2, 5, 11, 19, 23, 31, ... etc. are prime numbers.
11. **Co-primes:** Two numbers which have only 1 as the common factor are called 'co-primes'. 5 and 7 are co-primes. So are 15 and 16.
12. **Twin Primes:** Two prime numbers which differ by 2, are called 'twin primes', e.g., 3, 5; 5, 7; 11, 13; 71, 73 are some pairs of twin primes.
13. **Consecutive Numbers:** The numbers which are following or coming after other numbers in regular order, are called consecutive numbers. 4, 6, 8, 10 are consecutive even numbers and 9, 11, 13, 15 are consecutive odd numbers. 3, 4, 5, 6, 7 ..... etc. are consecutive numbers in the natural order of the number series.

TESTS FOR DIVISIBILITY OF NUMBERS

1. **Divisibility by 2:** A number is divisible by 2, if its units digit is 0, 2, 4, 6 or 8. For example, each of the numbers 130, 244, 566, 278, ... etc. is divisible by 2.
2. **Divisibility by 3:** A number is divisible by 3, if the sum of its digits is a multiple of 3. For example, each of the numbers 312, 213, 456 is divisible by 3 since sum of digits in each of these numbers is (3 + 1 + 2 = 6), (2 + 1 + 3 = 6) and (4 + 5 + 6 = 15) respectively, each of which is a multiple of 3.
3. **Divisibility by 4:** A number is divisible by 4, if the number formed by its digits in ten's and unit's places is divisible by 4. For example, numbers formed by ten's and unit's digits of 1132, 1312, 1400 and 1348 are 32, 12, 00 and 48 respectively which are divisible by 4. Hence, these numbers also are divisible by 4.
4. **Divisibility by 5:** A number is divisible by 5, if its unit's digit is either 0 or 5. For example, each of the numbers 100, 205, 315, 435 is divisible by 5 since unit's digit in each of these numbers is either 0 or 5.
5. **Divisibility by 6:** A number is divisible by 6, if it is divisible by both 2 and 3.
6. **Divisiblity by 8:** A number is divisible by 8, if the number formed by its digits in hundred's, ten's and unit's places is divisible by 8. For example, numbers formed by hundred's, ten's and unit's digits of 1864, 1024, 2008 and 5000 are 864, 024, 008 and 000 respectively which are divisible by 8. Hence, these numbers also are divisible by 8.
7. **Divisibility by 9:** A number is divisible by 9, if the sum of its digits is a multiple of 9. For example, each of the numbers 23409, 454554, 66636 is divisible by 9 since sum of digits in each of these numbers is (2 + 3 + 4 + 0 + 9 = 18), (4 + 5 + 4 + 5 + 5 + 4 = 27) and (6 + 6 + 6 + 3 + 6 = 27) respectively, each of which is a multiple of 9.
8. **Divisibility by 10:** A number is divisible by 10, if its unit's digit is zero. For example, each of the numbers 50, 80, 1310, 1400 is divisible by 10 since unit's digit in each of these numbers is 0.
9. **Divisibility by 11:** A number is divisible by 11, if the difference of the sum of its digits in even places and the sum of its digits in odd places (starting from unit's place) is either 0 or a multiple of 11. For example, each of the numbers 909183, 540045 and 184712 is divisible by 11 since in each of the numbers difference of the sum of digits in even places and sum of the digits in odd places is [(9 + 9 + 8) – (0 + 1 + 3) = 22], [(5 + 0 + 4) – (4 + 0 + 5) = 0] and [(8 + 7 + 2) – (1 + 4 + 1) = 11] respectively, each of which is either '0' or a multiple of '11'.
10. **Divisibility by 12:** A number is divisible by 12, if it is divisible by 3 and 4 both.

    For example, take a number 769824

    (*i*) Sum of digits = 7 + 6 + 9 + 8 + 2 + 4 = 36, it is divisible by 3.

    (*ii*) The number has 24 as its last two digits, which is divisible by 4.

    Hence, 769824 is divisible by 3 and 4 both, so it is divisible by 12.
11. **Divisibility by 14:** A number is divisible by 14, if it is divisible by 2 and 7 both.
12. **Divisibility by 15:** A number is divisible by 15, if it is divisible by 3 and 5 both.
13. **Divisibility by 16:** A number is divisible by 16, if the number formed by its last four digits is divisible by 16.

    For example, take a number 9877856, the number formed by its last four digits is 7856, which is divisible by 16. Hence, the number 9877856 is divisible by 16.
14. **Divisibility by 24:** A number is divisible by 24, if it is divisible by 3 and 8 both.
15. **Divisibility by 40:** A number is divisible by 40, if it is divisible by 5 and 8 both.
16. **Divisibility by 80:** A number is divisible by 80, if it is divisible by 5 and 16 both.

[Note: If a number is divisible by two co-primes separately, then the number will be also divisible by the product of co-primes.**]**

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EXERCISE

1. The difference between the squares of two consecutive numbers is 25. The numbers are—
A. 11, 12 B. 12, 13
C. 15, 14 D. 14, 13

2. The sum of two digits of a number is 15. If 9 is added to the number, the digits are reversed. The number is—
A. 78 B. 87
C. 69 D. 96

3. A number which when multiplied by 11 is as much above 180 as it was originally below it. The number is—
A. 25 B. 30
C. 40 D. 45

4. Divide ₹ 53 among X, Y, Z so that X may receive ₹ 7 more than Y, and Y may receive ₹ 8 more than Z.
A. 10, 15, 18 B. 18, 10, 25
C. 20, 12, 27 D. 25, 18, 10

5. If a = 16 and b = 15, then what is the value of $\frac{a^2+b^2+ab}{a^3-b^3}$ = ?
A. $\frac{1}{2}$ B. $\frac{1}{3}$
C. 1 D. 2

6. Find the number which when multiplied by 16 is increased by 225.
A. 13 B. 14
C. 15 D. 16

7. What is the largest number of four digits which is exactly divisible by 88?
A. 9999 B. 9988
C. 9944 D. 9998

8. If $\frac{a}{b}=\frac{4}{3}$, then $\frac{3a+2b}{3a-2b}$ = ?
A. 2 B. 3
C. 4 D. 5

9. If $\frac{x}{y}=\frac{3}{4}$, then the value of $\frac{6}{7}+\frac{y-x}{y+x}$ = ?
A. 1 B. 2
C. 3 D. 4

10. If the number $(10^n - 1)$ is divisible by 11, then n is—
A. odd number B. even number
C. any number D. multiple of 11

11. $\left(1-\frac{1}{3}\right)\left(1-\frac{1}{4}\right)\left(1-\frac{1}{5}\right)\ldots\left(1-\frac{1}{n}\right)$ = ?
A. $\frac{42}{29}$ B. $\frac{n-1}{n}$
C. $\frac{2}{n}$ D. 0

12. $\left(2-\frac{1}{3}\right)\left(2-\frac{3}{5}\right)\left(2-\frac{5}{7}\right)\ldots\left(2-\frac{997}{999}\right)$ = ?
A. $\frac{997}{999}$ B. ∞
C. $\frac{997}{3}$ D. $\frac{1001}{3}$

13. Divide 48 into two parts such that 7 times the first part added to 5 times the second part is 246. Find the first part.
A. 2 B. 3
C. 4 D. 5

14. The sum of a number and its reciprocal is thrice the difference of the number and its reciprocal. Find the number.
A. $\sqrt{2}$ B. $\sqrt{3}$
C. $\sqrt{5}$ D. $\sqrt{7}$

15. What should be added to the product of four consecutive odd numbers to make it a perfect square?
A. 13 B. 14
C. 15 D. 16

16. A boy was asked to find $\frac{7}{9}$ of a fraction. He made a mistake of dividing the fraction by $\frac{7}{9}$ and so got an answer which exceeded the correct answer by $\frac{8}{21}$. Find the correct answer.
A. 2/3 B. 5/7
C. 7/12 D. 7/15

17. If 40% of a number is 360, what will be 15% of 15% of that number?
A. 11.5 B. 20.25
C. 15.5 D. 21.75

18. The sum of two numbers is 25 and the difference of their square is 75. Find the difference between the numbers.
A. 2 B. 3
C. 4 D. 5

19. Ram eats 8 bananas in the morning, 5 in the afternoon and 2 in the evening. How many dozens of bananas does he eat in a day.
A. $1\frac{1}{4}$ B. $\frac{1}{4}$
C. $\frac{3}{13}$ D. $14\frac{17}{30}$

20. $47^{7.5} \div 47^{\frac{3}{2}} \times 47^{-3} = \left(\sqrt{47}\right)^{?}$ What should come in place of the question mark (?) in the following equation?
A. 5 B. 6
C. 7 D. 8

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ANSWERS

1	2	3	4	5	6	7	8	9	10
B	A	B	B	C	C	C	B	A	B
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
C	D	B	A	D	C	B	B	A	B

EXPLANATORY ANSWERS

1. Let the numbers are x and $(x + 1)$

$\therefore \quad (x+1)^2 - x^2 = 25$

$\Rightarrow \quad x^2 + 1 + 2x - x^2 = 25$

$\Rightarrow \quad 2x + 1 = 25$

$\Rightarrow \quad 2x = 25 - 1 = 24$

$\therefore \quad x = \frac{24}{2} = 12$

$\therefore \quad x + 1 = 12 + 1 = 13$

Hence, the numbers are 12, 13.

2. Let x be the digit in units place. Digit in ten's place is then $15 - x$.

$\therefore$ The number $= 10\,(15 - x) + x$

The new number with reverse digits

$= 10 \times x + (15 - x)$

$\therefore \quad 10(15 - x) + x + 9 = 10x + 15 - x$

$\Rightarrow \quad 150 - 10x + x + 9 = 9x + 15$

$\Rightarrow \quad 18x = 144$

$x = \frac{144}{18} = 8$

The digit of ten's place $= 15 - 8 = 7$

$\therefore$ The required number $= 78$.

3. Let the number is x

$\therefore \quad 180 - x = 11x - 180$

$\Rightarrow \quad 180 + 180 = 11x + x$

$\Rightarrow \quad 360 = 12x,$

$\Rightarrow \quad x = \frac{360}{12} = 30.$

4. Let Y receives ₹ a. Then X receives ₹ $(a + 7)$ and Z receives ₹ $(a - 8)$

But, $a + 7 + a + a - 8 =$ ₹ 53

$\Rightarrow \quad 3a - 1 = 53,$

$\Rightarrow \quad 3a = 53 + 1$

$\Rightarrow \quad 3a = 54,$

$\therefore \quad a = \frac{54}{3} =$ ₹ 18. = Y's share

X's share $= a + 7 = 18 + 7 =$ ₹ 25

Z's share $= a - 8 = 18 - 8 =$ ₹ 10.

5. Given $a = 16$ and $b = 15$, then $\frac{a^2+b^2+ab}{a^3-b^3}$

$= \frac{a^2+b^2+ab}{(a-b)\left(a^2+b^2+ab\right)} = \frac{1}{a-b} = \frac{1}{16-15} = 1$

6. Let the required no. $= x$

then, $16x - x = 225$

$\Rightarrow \quad 15x = 225 \ \therefore \ x = 15$

7. The greatest no. of 4 digit $= 9999$

Now, after dividing 9999 by 88, we get Remainder $= 55$

Hence, the largest 4 digit no. $= 9999 - 55 = 9944$

8. $\frac{3a+2b}{3a-2b} = \frac{3\frac{a}{b}+2}{3\frac{a}{b}-2} = \frac{3\times\frac{4}{3}+2}{3\times\frac{4}{3}-2} = \frac{6}{2} = 3$

9. $\frac{6}{7} + \frac{y-x}{y+x} = \frac{6}{7} + \frac{1-x/y}{1+x/y} = \frac{6}{7} + \frac{1-3/4}{1+3/4} = \frac{6}{7} + \frac{1}{7} = 1$

10. n is even number.

11. $\frac{2}{3}\times\frac{3}{4}\times\frac{4}{5}\times\ldots\times\frac{n-1}{n} = \frac{2}{n}$

12. $\frac{5}{3}\times\frac{7}{5}\times\frac{9}{7}\times\ldots\times\frac{1001}{999} = \frac{1001}{3}$

13. Let the first part $= x$

then 2nd part $= (48 - x)$

By question, $7x + 5(48 - x) = 246$

$\Rightarrow \quad 2x = 246 - 240 \ \therefore \ x = 3$

14. Let the no. $= x$

then its reciprocal $= \frac{1}{x}$

By the question, $\left(x+\frac{1}{x}\right) = 3\left(x-\frac{1}{x}\right)$

$\Rightarrow \quad \frac{x^2+1}{x} = \frac{3\left(x^2-1\right)}{x}$

$\Rightarrow \quad x^2 + 1 = 3x^2 - 3$

$\Rightarrow \quad 3x^2 - x^2 = 3 + 1 \ \therefore \ x = \sqrt{2}.$

15. Let the four consecutive odd numbers be $(2x - 3)$, $(2x - 1)$, $(2x + 1)$ and $(2x + 3)$

$\therefore$ Their product $= (2x - 1)\,(2x + 1)\,(2x - 3)\,(2x + 3)$

$= (4x^2 - 1)\,(4x^2 - 9) = 16x^4 - 40x^2 + 9$

$= (4x^2 - 5)^2 - 16$

Hence, on adding 16, the result will be a perfect square.

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16. Let the required fraction = x

then, by the question $x \div \frac{7}{9} - x \times \frac{7}{9} = \frac{8}{21}$

$\Rightarrow \quad x \times \frac{9}{7} - \frac{7x}{9} = \frac{8}{21} \Rightarrow \frac{32x}{63} = \frac{8}{21}$

$\Rightarrow \quad x = \frac{8}{21} \times \frac{63}{32} = \frac{3}{4}$

Hence, the correct answer $= \frac{3}{4} \times \frac{7}{9} = \frac{7}{12}$.

17. Let a number be x

then 40% of $x = 360$

$\Rightarrow \quad \frac{40}{100} \times x = 360$

$\therefore \quad x = 360 \times \frac{100}{40} = 900$

Now by the question,

15% of 15% of $900 = \frac{15}{100} \times \frac{15}{100} \times 900 = \frac{81}{4} = 20.25$.

18. Let two numbers are a and b

Given, $a + b = 25$

and $a^2 - b^2 = 75$

$\Rightarrow \quad (a + b)(a - b) = 75$

$\Rightarrow \quad (a - b) = \frac{75}{(a+b)} = \frac{75}{25} = 3.$

19. Total dozen of bananas Ram eats in a day

$= \frac{8}{12} + \frac{5}{12} + \frac{2}{12} = \frac{15}{12} = 1\frac{1}{4}$

20. $47^{7.5} \div 47^{\frac{3}{2}} \times 47^{-3} = \left(\sqrt{47}\right)^{?}$

Let ? = x

then $(47)^{\frac{15}{2}} \div (47)^{\frac{3}{2}} \times (47)^{-3} = (47)^{\frac{x}{2}}$

$\Rightarrow \quad (47)^{\frac{15}{2} - \frac{3}{2} - 3} = (47)^{\frac{x}{2}}$

$\Rightarrow \quad (47)^{\frac{6}{2}} = (47)^{\frac{x}{2}}$

$\therefore \quad x = 6.$

Decimal Fraction

FRACTION

The relation to represent some part of the body to the whole body is known *Fraction*. For example $\frac{2}{5}$ is a fraction where 2 is the numerator and 5 is the denominator.

Important Facts :

(i) A fraction is also called a rational number.

(ii) A fraction is unity when its numerator and denominator are equal.

(iii) When a fraction is reduced in its lowest term, its numerator and denominator are prime to each other, *i.e.*, they have no common factor.

(iv) The value of fraction is not altered by multiplying or dividing the numerator and the denominator by the same number.

Vulgar or Common Fraction : The fraction such as $\frac{2}{9}, \frac{7}{11}, \frac{3}{10}, \frac{9}{100}$ are called vulgar fraction.

Decimal Fraction : Fractions in which denomi-nators are power of 10 are called decimal fractions.

For example : $\frac{1}{10}, \frac{1}{100}, \frac{7}{1000}$ etc.

Here, $\frac{1}{10}$ is 1 tenths, written as .1

$\frac{1}{100} = .01$

$\frac{7}{1000} = .007$

$\frac{13}{100} = .13$ and so on.

Converting a Decimal into a Vulgar Fraction

First of all write down the given number as numerator without the decimal point, and for the denominator write 1 followed by as many zeros as many are there figures after the decimal point. Now reduce the fraction to its lowest terms.

Ex : *(i)* $0.63 = \frac{63}{100}$

(ii) $3.013 = 3\frac{013}{1000} = 3\frac{13}{1000}$

Addition and Subtraction of Decimal Fractions

First of all write down the numbers under one another. Other than the decimal point lies in one column. After arranging in this way, we add or subtract in usual fashion.

An example : Add $521 + 52.1 + 5.21 + 0.521$

Sol : 521.000
52.100
5.210
0.521 After adding we get 578.831

Multiplication of decimal fraction

1. To multiply by 10, 100, 1000, etc

Example : *(i)* $63.02 \times 10 = 630.2$

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(ii) $63.02 \times 100 = 6302$

(iii) $63.02 \times 1000 = 63020$

2. To multiply of two or more decimal fractions.

An example : *(i)* $5.91 \times 13 = 76.83$

(ii) $6.32 \times 0.59 = 3.7288$

(iii) $63.2 \times 0.01 = 0.632$

Conclusion: First of all multiply the given numbers assuming them without the decimal point. Now mark off the decimal point from extreme right in the product as many places of decimal as is the sum of the number of decimal places in the given numbers.

DIVISION OF DECIMALS

1. When the divisor is a counting number

Example : *(i)* $4.309 \div 10 = 0.4309$

(ii) $0.0182 \div 14 = 0.0013$

(iii) $9.586 \div 100 = 0.09586$

(iv) $0.05 \div 10^3 = 0.00005$

(v) $0.49 \div 7 = 0.07$

***Conclusion* :** *(i)* When divisor is the power of 10, then shift the decimal point to the left by as many places of decimal as is the power of 10, prefixing zero if necessary.

(ii) When divisor is other than power of 10, then divide as in the case of integers, and in quotient, put the decimal point to give as many places of decimal as are there in the dividend.

2. When the divisor is a decimal

Example:

(i) $0.00066 \div 0.11 = \dfrac{0.00066}{0.11} = \dfrac{0.066}{11} = 0.006$

(ii) $42 \div 0.07 = \dfrac{42}{0.07} = \dfrac{4200}{7} = 600$

(iii) $32.5 \div 0.0064 = \dfrac{32.5}{0.0064} = \dfrac{325000}{64} = 5078.125$

Recurring Decimal : If in a decimal number a digit or a set of digits is repeated again and again, the decimal is known as recurring decimal.

For example:

(i) $2.666... = 2.\dot{6}$

(ii) $1.363636... = 1.\dot{3}\dot{6}$ or $1.\overline{36}$

(iii) $7.3424242... = 7.3\dot{4}\dot{2}$ or $7.3\overline{42}$

Recurring decimal numbers are of two types:

***(i)* Pure recurring decimals :** A decimal fraction in which all the figures after the decimal point are repeated is called a pure recurring decimal. For example, $0.\overline{3}$, $0.\overline{37}$, $3.\overline{4579}$ etc

***(ii)* Mixed recurring decimals :** A decimal fraction in which at least one figure after the decimal point is not repeated is called a mixed recurring decimal. For example, $0.3\overline{59}$, $0.29\overline{54}$, $0.2\dot{7}$ etc.

Conversion of Recurring into Vulgar Fraction

1. Pure recurring decimals

Rule : Put as many 9's in the denominator at the number of digits under recurring and delete the recurring sign.

For example, $0.\overline{5} = \dfrac{5}{9}$

$0.\overline{35} = \dfrac{35}{99}$

$0.\overline{24} = \dfrac{24}{99} = \dfrac{8}{33}$

2. Mixed Recurring Decimals

For example,

(i) $0.1\overline{8}$

Here, numerator $= 18 - 1 = 17$

and denominator $= 9 \times 10 = 90$

$\therefore \quad 0.1\dot{8} = \dfrac{18-1}{90} = \dfrac{17}{90}$

(ii) $0.2\dot{7}\dot{9}$

Here, numerator $= 279 - 2 = 277$

and denominator $= 99 \times 10 = 990$

$\therefore \quad 0.2\overline{79} = \dfrac{279-2}{990} = \dfrac{277}{990}$

(iii) $0.3\overline{56} = \dfrac{356-3}{99\times 10} = \dfrac{353}{990}$

(iv) $2.53\dot{6} = 2 + \dfrac{536-53}{9\times 100} = 2 + \dfrac{483}{900}$

$= 2 + \dfrac{161}{300} = 2\dfrac{161}{300}$

(v) $0.4321\overline{3} = \dfrac{43213-43}{999\times 100}$

$= \dfrac{43170}{99900} = \dfrac{4317}{9990}$

Addition and Subtraction of recurring decimals

Example : *(i)* Add $3.\overline{76}$ and $1.45\overline{76}$ and subtract also.

3.7	676767	67	
1.4	576576	57	
(+) 5.2	253344	24	$\Rightarrow 5.2\overline{253344}$
(–) 2.3	100191	10	$\Rightarrow 2.3100191$

(ii) Subtract $3.\overline{75}$ from $25.5\overline{473}$

25.5	473473	47
3.7	575757	57
21.7	897715	90

Hence, the required subtract $= 21.7\overline{897715}$

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Multiplication and Division of Recurring Decimal

Example 1:

(*i*) $7.\overline{63} \times 11 = 7\frac{63}{99} \times 11$

$= 7\frac{7}{11} \times 11 = \frac{84}{11} \times 11 = 84$

(*ii*) $0.\overline{09} \times 7.\overline{3} = \frac{9}{99} \times 7\frac{3}{9}$

$= \frac{1}{11} \times \frac{66}{9} = \frac{6}{9} = 0.\overline{6}$

(*iii*) $0.\overline{6} \times 7.\overline{3} = \frac{6}{9} \times 7\frac{3}{9}$

$= \frac{6}{9} \times \frac{66}{9} = \frac{44}{9} = 4.\overline{8}$

(*iv*) $0.\overline{06} \div 100 = 0.060606... \div 100 = 0.00\overline{06}$

(*v*) $0.7\overline{32} \div 0.02\dot{7} = 0.73\dot{2}\dot{3} \div 0.02\dot{7}\dot{7}$

$= \frac{7323 - 73}{99 \times 100} \div \frac{277 - 2}{99 \times 100}$

$= \frac{7250}{9900} \div \frac{275}{9900} = \frac{7250}{275} = \frac{290}{11} = 26.\overline{36}.$

EXERCISE

1. Which of the following is equivalent to $\frac{15}{25}$?

A. $\frac{150}{25}$ B. $\frac{15}{250}$

C. $\frac{3}{5}$ D. $\frac{60}{75}$

2. If $\frac{9*3}{3*7}$ is equivalent to $\frac{9}{7}$, the sign * is replaced by

A. ÷ B. ×

C. + D. –

3. $\frac{5}{6}$ of an hour is equal to

A. half an hour B. 40 minutes

C. 50 minutes D. 55 minutes

4. An aircraft uses 2/5 of its fuel in flying 1,250 kilometres. The distance travelled on remaining fuel is

A. 1875 km B. 2125 km

C. 250 km D. 475 km

5. If $\frac{4}{3}*\frac{3}{4} = \frac{16}{9}$, then * means

A. + B. –

C. × D. ÷

6. Which of the following is the largest fraction?

$\frac{3}{15}, \frac{5}{20}, \frac{8}{64}, \frac{25}{1000}$

A. $\frac{3}{15}$ B. $\frac{5}{20}$

C. $\frac{8}{64}$ D. $\frac{25}{1000}$

7. Six times x increased by 12 is equal to

A. $\frac{x}{2}$ B. $2x$

C. $6x + 12$ D. $12x + 6$

8. Five times y diminished by 20 is equal to

A. $5y - 20$ B. $5y + 20$

C. $y/4$ D. $4y$

9. The number less than 15 by 7 is

A. $15x - 7$ B. 15/7

C. 15 D. 8

10. If 21 is add to four times a number, the result is 57. The number is

A. 7 B. 8

C. 9 D. 10

11. A number, the sum of whose fourth and fifth parts exceeds their third part by 28, is

A. 120 B. 240

C. 220 D. 160

12. Which fraction should be added to the sum of $5\frac{3}{4}$, $4\frac{4}{5}$ and $7\frac{3}{8}$ to make the result a whole number?

A. $\frac{1}{40}$ B. $\frac{2}{40}$

C. $\frac{3}{40}$ D. $\frac{4}{40}$

13. $\frac{1}{15} + \frac{3}{15} + \frac{5}{15} + \frac{6}{15} = ?$

A. $\frac{10}{15}$ B. $\frac{3}{5}$

C. $\frac{4}{5}$ D. 1

14. A number one-sixth of which exceeds its one-ninth by 100 is

A. 600 B. 900

C. 1500 D. 1800

15. The sum of 1/2, 1/4 and 1/8 of a number is 28. The number is

A. 28 B. 32

C. 36 D. 42

16. The sum of 1/9, 1/3, 1/6 and 7/18 of a number is 150. The number is

A. 120 B. 130

C. 140 D. 150

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17. Which is the greatest?
.999, .1011, .1995, .9985
A. .999 B. .1011
C. .1995 D. .9985

18. In decimal system, $9\frac{1}{8}$ may be represented as
A. 9.18 B. 9.125
C. 9.025 D. 9.225

19. 2.205 ÷ 0.15 = ?
A. 1.47 B. 14.7
C. 147 D. 0.147

20. G.C.M. of .24, 3.2 and 16.0 is
A. 80 B. 8
C. .8 D. .08

ANSWERS

1	2	3	4	5	6	7	8	9	10
C	B	C	A	D	B	C	A	D	C
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
B	C	D	D	B	D	A	B	B	D

EXPLANATORY ANSWERS

1. $\frac{15}{25} = \frac{3\times5}{5\times5} = \frac{3}{5}$

2. $\frac{9*3}{3*7} = \frac{9}{7}$, or, $\frac{9\times3}{7\times3} = \frac{9}{7}$, ∴ The sign * is ×.

3. $\frac{5}{6}$ of 1 hr. $= \frac{5}{6}\times60$ minutes $= 50$ minutes.

4. Remaining fuel $= 1-\frac{2}{5} = \frac{5-2}{5} = \frac{3}{5}$

Distance flown by $\frac{2}{5}$ of fuel = 1250 km.

Distance flown by full fuel $= \frac{1250}{2/5} = \frac{1250\times5}{2}$ km.

Distance flown by $\frac{3}{5}$ of fuel

$= \frac{1250\times5\times3}{2\times5} = 1875$ km.

6. $\frac{3}{15} = \frac{1}{5}$, $\frac{8}{64} = \frac{1}{8}$, $\frac{5}{20} = \frac{1}{4}$, $\frac{25}{1000} = \frac{1}{40}$

Now, the fractions are $\frac{1}{5}, \frac{1}{4}, \frac{1}{8}, \frac{1}{40}$

∴ The largest fraction is $\frac{1}{4} = \frac{5}{20}$

7. $x \times 6 + 12 = 6x + 12$

8. $5 \times y - 20 = 5y - 20$

9. $15 - 7 = 8$

10. Let the number be x

$\therefore \quad 4x + 21 = 57$ or, $4x = 57 - 21 = 36$

Hence, $x = \frac{36}{4} = 9$

11. Let the number be x

$\therefore \quad \frac{x}{4}+\frac{x}{5} = \frac{x}{3}+28$

$\Rightarrow \quad \frac{9x}{20} = \frac{x}{3}+28 \Rightarrow \frac{9x}{20}-\frac{x}{3} = 28$

$\Rightarrow \frac{27x-20x}{60} = 28 \therefore x = \frac{28\times60}{7} = 240.$

12. $5\frac{3}{4}+4\frac{4}{5}+7\frac{3}{8} = \frac{23}{4}+\frac{24}{5}+\frac{59}{8} = \frac{717}{40}$

717/40 becomes whole number when 3/40 is added to it, *i.e.,*

$\frac{717}{40}+\frac{3}{40} = \frac{720}{40} = 18$ which is a whole number.

13. $\frac{1}{15}+\frac{3}{15}+\frac{5}{15}+\frac{6}{15} = \frac{1+3+5+6}{15} = \frac{15}{15} = 1$

14. Let the number be x

$\frac{x}{6} = \frac{x}{9}+100$

$\Rightarrow \quad \frac{x}{6}-\frac{x}{9} = 100, \Rightarrow \frac{x}{18} = 100$

$\therefore \quad x = 100 \times 18 = 1800.$

15. Let the number be x

$\therefore \quad \frac{x}{2}+\frac{x}{4}+\frac{x}{8} = 28 \Rightarrow \frac{7x}{8} = 28$

$\therefore \quad x = \frac{28\times8}{7} = 32.$

16. Let the number be x

$\therefore \quad \frac{x}{9}+\frac{x}{3}+\frac{x}{6}+\frac{7x}{18} = 150$

$\Rightarrow \quad \frac{2x+6x+3x+7x}{18} = \frac{18x}{18} = 150 \therefore x = 150.$

17. .999 is the greatest.

18. $9\frac{1}{8} = 9+\frac{1}{8} = 9 + .125 = 9.125$

19. $2.205 \div 0.15 = \frac{2.205}{.15} = \frac{2205}{1000}\times\frac{100}{15} = \frac{2205}{150} = 14.7.$

20. G.C.M. of .24, 3.2 and 16.0

$= \text{G.C.M. of } \frac{24, 320 \text{ and } 1600}{100} = \frac{8}{100} = 0.08$

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Relation Between Numbers

Simplification is a mathematical operation by which a complex expression of numbers or fractions is converted into a simpler or less difficult form. It is erroneous to solve this type of questions on random basis and a very appropriate method is to apply BODMAS Rule for arriving at the solution of such problems. Each of the letters of the word 'BODMAS' when explained serially, has following implications:

1.	B	→	Bracket	[{ (¯) }]
2.	O	→	of	of
3.	D	→	Division	÷
4.	M	→	Multiplication	×
5.	A	→	Addition	+
6.	S	→	Subtraction	–

Therefore, for simplification, we should remove the brackets first. Thereafter operation for 'of', then for 'division', after that the operation for 'multiplication' and thereafter for 'addition' and at last operation for 'subtraction' should be carried out.

Important Notes

A. In mathematical operations the word 'of' indicates multiplication.

B. While removing brackets, first of all bar bracket '–' and after that small bracket '( )' is removed. Thereafter the curly bracket '{ }' and at last square bracket [ ] is removed.

EXERCISE

1. The value of 51 ÷ 17 ÷ 3 is:
A. 9 B. 4
C. 3 D. 1

2. What will be the value of
40 × 2 ÷ 10 + 5 – 4?
A. 5 B. 8
C. 11 D. 9

3. The value of 28 × 104 ÷ (18 + 6) + 3 is:
A. $124\frac{1}{3}$ B. $104\frac{1}{3}$
C. $125\frac{1}{3}$ D. 128

4. If $75^2 - 65^2 = 2x$, then value of x is:
A. 715 B. 700
C. 688 D. 711

5. The value of 99 × 14 ÷ 11 ÷ 0.7 is:
A. 2.9 B. 1.6
C. 1.8 D. 2.8

6. If 45 – [28 – {37 – (15 – ?) }] = 58, then which of the following should replace the sign of interrogation (?)?
A. 18 B. 17
C. 13 D. 19

7. The value of $8\frac{1}{3}+5\frac{1}{4}\times13\frac{1}{5}\div6\frac{3}{5}$ is:
A. $19\frac{1}{3}$ B. $18\frac{5}{6}$
C. $21\frac{1}{3}$ D. $22\frac{1}{2}$

8. The value of $\frac{14}{3}$ of $\frac{5}{8}$ of 72 is:
A. 209 B. 217
C. 210 D. 199

9. What will be the value of
10 × 10 × 10 ÷ (20 ÷ 10 × 10 – 10) + 6?
A. 108 B. 111
C. 106 D. 114

10. What will be the value of $\frac{\frac{1}{3}\times20\div4}{\frac{1}{4}\times25\div5}$?
A. 7/3 B. 4/3
C. 5/3 D. 10/3

11. Which of the following is the standard form of $\frac{(24\times13)+(28\div7)}{(24+13)-\left(\frac{14}{3}\text{ of }\frac{5}{8}\right)}$?
A. $\frac{3792}{409}$ B. $\frac{4792}{309}$
C. $\frac{3792}{411}$ D. $\frac{3092}{409}$

12. If $\frac{144+32\div?-8}{35\div\frac{1}{2}\text{ of }\frac{1}{2}}=1$, then which of the following should replace the sign of interrogation?
A. 7 B. 6
C. 10 D. 8

13. What is the value of
$\frac{2.70\times2.70+4.30\times4.30+8.60\times2.70}{2.70+4.30}$?
A. 6.8 B. 7.0
C. 7.6 D. 8.5

14. What will be the value of $\frac{\left(\sqrt{6}+\frac{1}{\sqrt{6}}\right)^2}{\frac{1}{2}\text{of }18\ +\ 4}+\frac{2}{3}$?
A. 101/78 B. 104/71
C. 101/88 D. 99/57

15. 1150 ÷ 50 ÷ 23 + 15 = ?
A. 16 B. 20
C. 22 D. 18

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ANSWERS

1	2	3	4	5	6	7	8	9	10
D	D	A	B	C	D	B	C	C	B
11	**12**	**13**	**14**	**15**					
A	D	B	A	A					

EXPLANATORY ANSWERS

1. $\because 51 \div 17 \div 3 = \frac{51}{17} \div 3 = 3 \div 3 = \frac{3}{3} = 1$

2. $\because 40 \times 2 \div 10 + 5 - 4$

$= 40 \times \frac{2}{10} + 5 - 4 = 8 + 5 - 4 = 9.$

3. $\because 28 \times 104 \div (18 + 6) + 3$

$= 28 \times 104 \div 24 + 3$

$= 28 \times \frac{104}{24} + 3 = 28 \times \frac{13}{3} + 3$

$= \frac{364}{3} + 3 = \frac{373}{3} = 124\frac{1}{3}$

4. $\because 75^2 - 65^2 = 2x$

$\Rightarrow (75 + 65)(75 - 65) = 2x$

$[\because a^2 - b^2 = (a + b)(a - b)]$

$\Rightarrow 140 \times 10 = 2x \Rightarrow x = 70 \times 10 = 700$

$\therefore$ Value of x is 700.

5. $\because .99 \times 14 \div 11 \div 0.7$

$= .99 \times \frac{14}{11} \div 0.7 = \frac{.99 \times 14}{11 \times 0.7} = 1.8$

6. $\because 45 - [28 - \{37 - (15 - ?)\}] = 58$

$\Rightarrow 45 - [28 - \{37 - 15 + ?\}] = 58$

$\Rightarrow 45 - [28 - \{22 + ?\}] = 58$

$\Rightarrow 45 - [28 - 22 - ?] = 58$

$\Rightarrow 45 - 28 + 22 + ? = 58$

$\Rightarrow 39 + ? = 58$

$\Rightarrow ? = 58 - 39 = 19$

Therefore, the interrogation sign should be replaced by 19.

7. $\because 8\frac{1}{3} + 5\frac{1}{4} \times 13\frac{1}{5} \div 6\frac{3}{5}$

$= \frac{25}{3} + \frac{21}{4} \times \frac{66}{5} \div \frac{33}{5} = \frac{25}{3} + \frac{21}{4} \times \frac{66}{5} \times \frac{5}{33}$

$= \frac{25}{3} + \frac{21}{2} = \frac{50 + 63}{6} = \frac{113}{6} = 18\frac{5}{6}$

8. $\because \frac{14}{3}$ of $\frac{5}{8}$ of $72 = \frac{14 \times 5 \times 72}{3 \times 8} = 210$

9. $10 \times 10 \times 10 \div (20 \div 10 \times 10 - 10) + 6$

$= 10 \times 10 \times 10 \div \left(\frac{20}{10} \times 10 - 10\right) + 6$

$= 10 \times 10 \times 10 \div (20 - 10) + 6$

$= 10 \times 10 \times 10 \div 10 + 6$

$= 10 \times 10 \times \frac{10}{10} + 6$

$= 10 \times 10 \times 1 + 6 = 100 + 6 = 106$

10. $\because \frac{\frac{1}{3} \times 20 \div 4}{\frac{1}{4} \times 25 \div 5} = \frac{\frac{1}{3} \times 5}{\frac{1}{4} \times 5} = \frac{\frac{5}{3}}{\frac{5}{4}} = \frac{4}{3}$

11. $\because \frac{(24 \times 13) + (28 \div 7)}{(24 + 13) - \left(\frac{14}{3} \text{ of } \frac{5}{8}\right)} = \frac{312 + 4}{37 - \frac{35}{12}} = \frac{316}{\frac{409}{12}} = \frac{3792}{409}$

12. If $\frac{144 + 32 \div ? - 8}{35 \div \frac{1}{2} \text{ of } \frac{1}{2}} = 1 \Rightarrow \frac{144 + \frac{32}{?} - 8}{35 \div \frac{1}{4}} = 1 \Rightarrow \frac{136 + \frac{32}{?}}{\frac{35}{\frac{1}{4}}} = 1$

$\Rightarrow 136 + \frac{32}{?} = 35 \times 4 = 140$

$\Rightarrow \frac{32}{?} = 140 - 136 = 4 \Rightarrow ? = \frac{32}{4} = 8$

$\therefore$ Sign of interrogation (?) will be replaced by 8.

13. $\frac{2.70 \times 2.70 + 4.30 \times 4.30 + 8.60 \times 2.70}{2.70 + 4.30}$

$= \frac{(2.70)^2 + (4.30)^2 + 2 \times 4.30 \times 2.70}{2.70 + 4.30}$

$= \frac{(2.70 + 4.30)^2}{2.70 + 4.30}$ $[\because a^2 + b^2 + 2ab = (a + b)^2]$

$= 2.70 + 4.30 = 7.00$

14. $\therefore \frac{\left(\sqrt{6} + \frac{1}{\sqrt{6}}\right)^2}{\frac{1}{2} \text{ of } 18 + 4} + \frac{2}{3} = \frac{\left(\sqrt{6}\right)^2 + \left(\frac{1}{\sqrt{6}}\right)^2 + 2.\sqrt{6}\frac{1}{\sqrt{6}}}{9 + 4} + \frac{2}{3}$

$= \frac{6 + \frac{1}{6} + 2}{13} + \frac{2}{3} = \frac{\frac{49}{6}}{13} + \frac{2}{3} = \frac{49}{78} + \frac{2}{3} = \frac{101}{78}$

15. $1150 \div 50 \div 23 + 15$

$= \frac{1150}{50} \div 23 + 15 = 23 \div 23 + 15 = \frac{23}{23} + 15$

$= 1 + 15 = 16.$

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CHAPTER 2

Comparing Quantities

Percentage

The word 'per cent' or 'percentage' means 'for every one hundred'. In other words, it gives an indication of rate per hundred. It is denoted by the symbol %.

For example, 5% means 5 out of one hundred or $\frac{5}{100}$.

Remember:

(*i*) For converting a per cent into a fraction, divide it by 100.

(*ii*) For converting a fraction into a per cent, multiply it by 100.

(*iii*) For converting a per cent into a decimal, shift the decimal point two places to the left.

(*iv*) For converting one given quantity *(x)* as a percentage of another given quantity *(y)*, find $\frac{x}{y}\times 100$.

(*v*) There is no unit of percentage.

Important Facts—For quickly solving the problems related to percentage, remember following rules:

Rule 1:

(***a***) Of the given two numbers if the first is *x*% more than the second, then the second will be $\left(\frac{100\times x}{100+x}\right)\%$ less than the first.

(***b***) Of the given two numbers if the first is *x*% less than the second, then the second will be $\left(\frac{100\times x}{100-x}\right)\%$ more than the first.

(***c***) If two numbers are respectively *x*% and *y*% more than a third number, then the first number will be $\left(\frac{100+x}{100+y}\times 100\right)\%$ of the second.

(***d***) If two numbers are respectively *x*% and *y*% less than a third number, then the first number will be $\left(\frac{100-x}{100-y}\times 100\right)\%$ of the second.

Rule 2:

(***a***) If a number or quantity is increased by *x*% then in order to restore its original value it must be decreased by $\left[\frac{100\times x}{100+x}\right]\%$.

(***b***) If a number or quantity is decreased by *x*% then in order to restore its original value it must be increased by $\left[\frac{100\times x}{100-x}\right]\%$.

Rule 3:

(***a***) If a number is successively increased by *x*% and *y*% then a single equivalent increase in that number will be $\left(x+y+\frac{xy}{100}\right)\%$

(***b***) If two successive discounts of *x*% and *y*% are allowed on a particular amount, then a single discount that is equivalent to the two successive discounts will be $\left(x+y-\frac{xy}{100}\right)\%$

(***c***) If a number is successively increased by *x*%, *y*% and *z*%, then a single equivalent increase in that number will be $\left[(x+y+z)+\left(\frac{xy+yz+zx}{100}\right)+\frac{(xyz)}{10000}\right]\%$

(***d***) If three successive discounts of *x*%, *y*% and *z*% are allowed on an amount, then a single discount that is equivalent to the three successive discounts will be $\left[x+y+z-\frac{(xy+yz+zx)}{100}+\frac{xyz}{10000}\right]\%$

Rule 4:

(***a***) If a number is increased by *x*% and thereafter reduced by *x*%, then the number will be reduced by $\left(\frac{x^2}{100}\right)$ per cent.

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(*b*) If a number is reduced by $x\%$ and thereafter increased by $x\%$ then the number will be reduced by $\left(\frac{x^2}{100}\right)$ per cent.

(*c*) If due to an increase of $x\%$ in the selling price of certain commodity the sell/consumption of the commodity decreases by $y\%$, then gross receipts on account of sale of that commodity will be increased or decreased by $\left(x - y - \frac{xy}{100}\right)\%$,

where $x > y$ and will be decreased by $\left(y - x + \frac{xy}{100}\right)\%$,

where $y > x$.

EXERCISE

1. In the expression xy^2, the values of both variables x and y are decreased by 20%. By this, the value of the expression is decreased by
A. 40% B. 48.8%
C. 51.2% D. 80%

2. 15 litres of mixture contains 20% alcohol and rest water. If 3 litres of water be mixed in it, the percentage of alcohol in the new mixture will be:
A. 15 B. $16\frac{2}{3}$
C. 17 D. $18\frac{1}{2}$

3. The difference between 70% and 55% of a number is 72. The number is:
A. 370 B. 460
C. 480 D. 520

4. 20% of a number is 10% of:
A. half the number
B. double the number
C. ten times the number
D. twenty times the number

5. 75% of what area is 15 sq. metres?
A. 10 sq. metres B. 15 sq. metres
C. 20 sq. metres D. 25 sq. metres

6. In an examination 80% of the students passed in Mathematics and 70% passed in English, while 10% students failed in both the subjects. If 360 students passed in both the subjects, find the total number of students who appeared in the examination.
A. 400 B. 600
C. 630 D. 640

7. In an election, there are two candidates. A candidate secured 57% of the total votes polled and elected by a margin of 2100 votes. Find the total number of votes polled.
A. 15000 B. 17500
C. 18000 D. 21000

8. Electric tax is increased by 20% and its consumption is decreased by 20%. The change in the expenditure is:
A. 4% decrease B. 4% increase
C. 5% decrease D. 5% increase

9. A man loses 10% of his money, after spending 20% of the remainder he is left with ₹ 2160. Initially the man had:
A. ₹ 1800 B. ₹ 2500
C. ₹ 3000 D. ₹ 3200

10. In a school 55% of the students are below 9 years of age and the remaining 153 above 9 years of age. The total number of students in the school is:
A. 296 B. 300
C. 340 D. 1000

11. The selling price of certain commodity was reduced by 25%. As a result of it, the sales increased by 30%. What was the effect of it on cash collected by daily sales?
A. 2.5% decrease B. 2.5% increase
C. 5% decrease D. 5% increase

12. A cooler marked at ₹ 1500 is offered at ₹ 1350 due to off-season discount. Find the rate of off-season discount offered.
A. 9.5% B. 10%
C. 10.5% D. 12%

13. The number of Gypsy-cars sold in 2008 was 16,500 and that sold in 2007 was 16580. How much was the percentage decrease in sales of the Gypsy-cars from 2007 to 2008?
A. less than 1 per cent
B. more than 1 per cent
C. zero per cent
D. cannot be determined

14. A company decided to sell ₹ 50,000 T.V. set for ₹ 48,000 as a world cup offer. What is the percentage discount offered by the company?
A. 6.5 B. 7
C. 7.5 D. 4

15. 9% of a number is $\frac{81}{200}$, what is $\frac{2}{7}$ of that number?
A. $1\frac{1}{5}$ B. $1\frac{2}{7}$
C. $2\frac{1}{7}$ D. $2\frac{1}{5}$

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ANSWERS

1	2	3	4	5	6	7	8	9	10
B	B	C	B	C	B	A	A	C	C
11	**12**	**13**	**14**	**15**					
A	B	A	D	B					

EXPLANATORY ANSWERS

1. Decrease in expression

$= xy^2 - \frac{80}{100} \times x\left(\frac{80}{100}y\right)^2 = xy^2 - \frac{64}{125}xy^2 = \frac{61xy^2}{125}$

Hence, decrease per cent

$= \frac{61xy^2}{125 \times xy^2} \times 100 = 48.8\%$

2. Amount of alcohol $= \frac{20}{100} \times 15 = 3$ litre

Hence, required percentage $= \frac{3}{18} \times 100 = 16\frac{2}{3}\%$

3. Let the number be x; then

$(70 - 55) \times \frac{1}{100} \times x = 72$

$\therefore \quad x = \frac{100 \times 72}{15} = 480$

4. Let number be 100, then 20% and 10% of the number be 20 and 10 respectively.

Hence, 20% of a number is 10% of double the number.

5. Let required area be x sq. metre; then

$\frac{75}{100} \times x = 15$

$\therefore \quad x = \frac{15 \times 100}{75} = 20$ sq metre

6. Here, percentage of students failed in Mathematics and English be 30% and 20% respectively.

Percentage of students failed either one or both subjects $= 30 + 20 - 10 = 40\%$

Hence, percentage of pass students $= 100 - 40 = 60\%$

Now, $\quad 60\% = 360$

$\therefore \quad 100\% = \frac{360}{60} \times 100 = 600$

7. Let total number of votes be x; then

$(57 - 43) \times \frac{1}{10}x = 2100$

$\therefore \quad x = \frac{100 \times 2100}{14} = 15000$

8. Let initially electric tax is ₹ 100 and consumption = 100 units

Decrease in consumption

$= 100 \times 100 - 120 \times 80 =$ ₹ 400

Hence, decrease percentage $= \frac{400 \times 100}{100 \times 100} = 4\%$

9. Let initally the man had ₹ x, then

amount of money loses $= \frac{10}{100} \times x = ₹\frac{x}{10}$

Remaining amount of money $= x - \frac{x}{10} = ₹\frac{9x}{10}$

Money spent $= \frac{20}{100} \times \frac{9x}{10} = ₹\frac{9x}{50}$

Now, $\quad \frac{9x}{10} - \frac{9x}{50} = 2160 \Rightarrow \frac{36x}{50} = 2160$

$\therefore \quad x = \frac{2160 \times 50}{36} =$ ₹ 3000

10. Let total number of students be x, then

$\frac{45}{100} \times x = 153 \quad \therefore \quad x = \frac{100 \times 153}{45} = 340$

11. Let the selling price of a commodity be ₹ 100 and number of sales = 100 units

Decrease in daily cash

$= 100 \times 100 - 75 \times 130 =$ ₹ 250

Hence, decrease percentage $= \frac{250 \times 100}{100 \times 100} = 2.5\%$

12. Discount per cent

$= \frac{1500 - 1350}{1500} \times 100 = \frac{150}{1500} \times 100 = 10\%$

13. Required decrease percentage

$= \frac{16580 - 16500}{16580} \times 100 = \frac{80}{16580} \times 100 = 0.48\%$

14. Discount per cent $= \frac{2000}{50{,}000} \times 100 = 4\%$

15. Let the number be x; then

$\frac{9}{100} \times x = \frac{81}{200} \quad \therefore \quad x = \frac{100 \times 81}{9 \times 200} = \frac{9}{2}$

Hence, $\frac{2}{7}x = \frac{2}{7} \times \frac{9}{2} = \frac{9}{7} = 1\frac{2}{7}$.

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Discount

Market Price (M.P.)—The attached price is called the market price (M.P.) or list price (L.P.) of the article and the reduction allowed in the price is called the **discount**.

(*i*) Discount = M.P. – S.P.

(*ii*) $\text{Discount } \% = \dfrac{\text{Discount} \times 100}{\text{M.P.}}$

(*iii*) $\text{S.P.} = \text{M.P.} - \dfrac{\text{Discount\%} \times \text{M.P.}}{100}$

(*iv*) $\text{S.P.} = \text{M.P.} \times \left(1 - \dfrac{\text{Discount}\,\%}{100}\right)$

(*v*) $\text{M.P.} = \dfrac{100 \times \text{S.P.}}{100 - \text{Discount\%}}$

$\text{S.P.} = \text{M.P.} \left(\dfrac{100 - \text{Discount}\,\%}{100}\right)$

$\text{M.P.} - \text{S.P.} = \dfrac{\text{M.P.} \times \text{Discount\%}}{100}$

$\text{Discount\%} = \left(\dfrac{\text{M.P.} - \text{S.P.}}{\text{M.P.}}\right) \times 100$

EXERCISE

1. A cloth merchant offers 15% festival discount on every saree sold. If a certain saree is sold for ₹ 680, what is its marked price?
A. ₹ 800 B. ₹ 900
C. ₹ 1250 D. ₹ 1300

2. A shopkeeper offers 10% discount on an article and still makes a profit of 20%. What is the C.P. of the article if the marked price is ₹ 350?
A. ₹ 259.20 B. ₹ 262.50
C. ₹ 265.75 D. ₹ 272.5

3. A manufactures marks his goods in such a way that after allowing 20% discount, he makes a profit of 18%. What is the marked price of an item which costs him ₹ 200?
A. ₹ 295 B. ₹ 310
C. ₹ 315 D. ₹ 375

4. The marked price of a brand of coffee is ₹ 35 for 100g. But the shopkeeper gives a cup costing ₹ 7.50 free with it. Even then he gets a gain of 10%. What is the cost price of 100g of coffee?
A. ₹ 15 B. ₹ 25
C. ₹ 35 D. ₹ 65

5. A car is marked at ₹ 2,25,000. The manufacturer gives a discount of 10%. The dealer also gives a discount of 5%. What is the S.P. of the car?
A. ₹ 1,72,369 B. ₹ 1,64,370
C. ₹ 1,52,393 D. ₹ 1,92,375

6. A cycle merchant allows 25% commission on his advertised price and still makes a profit of 20%. If he gains ₹ 60 over the sale of one cycle. What is his advertised price?
A. ₹ 290 B. ₹ 310
C. ₹ 480 D. ₹ 520

7. The marked price of a shirt was ₹ 165 and it was at a discount of 12%. What the selling price of the shirt?
A. ₹ 145.20 B. ₹ 155.30
C. ₹ 165.20 D. ₹ 175.25

8. A trader marks his goods 40% above the cost price and gives a discount of 20% on the marked price. What is his gain per cent?
A. 8% B. 9%
C. 12% D. 15%

9. How much per cent more than the C.P. should a manufacturer mark his goods so that after allowing a discount of 20% on the marked price, he gains 10%.
A. 34.5% B. 27.5%
C. 37.5% D. 38.5%

10. A shopkeeper allows a discount of 10% to his customers and still gains 20%. What is the marked price of an article which costs ₹ 450 to the shopkeeper?
A. ₹ 600 B. ₹ 700
C. ₹ 800 D. ₹ 900

ANSWERS

1	2	3	4	5	6	7	8	9	10
A	B	A	B	D	C	A	C	C	A

EXPLANATORY ANSWERS

1. S.P. = ₹ 680, Discount = 15%

$$\text{M.P.} = \frac{100 \times \text{S.P.}}{100 - \text{Discount}\,\%}$$

$$= \frac{100 \times 680}{100 - 15} = \frac{100 \times 680}{85} = ₹\ 800$$

2. C.P. = ₹ x, 120% of x = 350 – 350 × 10%

$$\frac{120}{100} \times x = 350 - 35 = 315.$$

$$x = \frac{315 \times 5}{6} = \frac{525}{2}, \text{ C.P.} = ₹\ 262.50.$$

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3. Let M.P. = ₹ x

$80\%\ x = 118\%$ of 200

$$\frac{80}{100}\times x = \frac{118}{100}\times 200 \Rightarrow x = \frac{236\times 5}{4} = ₹\ 295.$$

4. Let C.P. of 100 gm coffee = ₹ x

110% of $x = 35 - 7.50 = 27.50$

$$\frac{110}{100}\times x = 27.50$$

$$x = \frac{27.50\times 100}{110\times 100}$$

C.P. = ₹ 25.

5. M.P. = ₹ 225000

$$\text{1st S.P.} = 225000 - 225000\times\frac{10}{100}$$

$$= 225000 - 22500 = 202500$$

$$\text{2nd S.P.} = 202500 - 202500\times\frac{5}{100}$$

$$= 202500 - 10125 = ₹\ 192375$$

6. Let M.P. = 100

Commission = 25%

S.P. = 100 – 25 = 75

Profit = 20%

$$\text{C.P.} = \frac{100}{120}\times 75 = \frac{375}{6} = 62.50$$

Gain = 75 – 62.50 = ₹ 12.50

$$\text{M.P.} = \frac{100}{12.50}\times 60 = ₹\ 480$$

7. $$\text{S.P.} = \frac{\text{M.P.}(100 - \text{Discount})}{100}$$

$$= \frac{165\times(100-12)}{100} = \frac{165\times 88}{100}$$

$$= 33\times 4.4 = ₹\ 145.20$$

8. Let C.P. = 100, M.P. = 140, Discount = 20%

$$\text{S.P.} = 140 - 140\times\frac{20}{100} = 140 - 28 = 112$$

Profit = 112 – 100 = 12

$$\text{Profit \%} = \frac{12\times 100}{100} = 12\%$$

9. Let C.P. = ₹ x, S.P. = 110% of $x = \frac{110}{100}\times x = \frac{11}{10}x$.

Discount = 20%

$$\text{M.P.} = \frac{100\times\frac{11}{10}x}{100-20} = \frac{100\times\frac{11}{10}x}{80} = \frac{11}{8}x.$$

$$\text{Required \%} = \frac{\frac{11x}{8} - x}{x}\times 100 = \frac{3x\times 100}{8x} = 37.5\%$$

10. C.P. = 450, Gain = 20%

$$\text{S.P.} = 450 + 450\times\frac{20}{100} = 450 + 90 = 540$$

Discount = 10%

$$\text{M.P.} = \frac{100\times\text{S.P.}}{100 - \text{Discount}} = \frac{100\times 540}{100-10}$$

$$= \frac{100\times 540}{90} = ₹\ 600$$

Profit & Loss

A consumer who goes to the market and buys certain goods. The buyer is called a customer and the shopkeeper who sells the goods to him is called a retailer. The retailer purchases goods in turn in bulk from a wholesaler who keeps a large stock of good and in this case, the retailer becomes the customer.

1. **Cost price (C.P.):** Cost price is that price at which a particular article is bought. Profit and loss both are marked at cost price.
2. **Selling Price (S.P.):** Selling price is that price at which a particular article is sold.
3. **Overheads:** The expenses incurred on transportation, maintenance, packaging, advertise-ments and the like are included as *Overhead.* These overheads and the profit when added to the cost price determine the selling price.
4. **Profit or Gain** : Whenever a person sells an article at price greater than the cost price he is said to have made a profit or gain.
   Profit or Gain = S.P. – C.P.
5. **Loss :** If S.P. is less than the C.P. there is loss.
   Loss = C.P – S.P

Some Basic Formulae:

(i) Gain = S.P. – C.P.

(ii) Loss = C.P. – S.P.

(iii) $$\text{Gain \%} = \frac{\text{Gain}\times 100}{\text{C.P.}}$$

(iv) $$\text{Loss \%} = \frac{\text{Loss}\times 100}{\text{C.P.}}$$

From these we can write direct expressions for S.P. and C.P.

(v) $$\text{S.P.} = \left(\frac{100 + \text{Gain\%}}{100}\right)\times \text{C.P. in case of gain or profit}$$

(vi) $$\text{S.P.} = \left(\frac{100 - \text{Loss\%}}{100}\right)\times \text{C.P. in case of loss}$$

These can be rewritten as

$$\text{C.P.} = \frac{100}{100 + \text{Gain\%}}\times \text{S.P. in case of profit}$$

$$\text{C.P.} = \frac{100}{100 - \text{Loss\%}}\times \text{S.P. in case of loss}$$

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(vii) If the C.P. of x goods = S.P. of y goods, then

(a) Gain % $= \frac{x-y}{y} \times 100$ [In case of $x > y$]

(b) Loss % $= \frac{y-x}{y} \times 100$ [In case of $y > x$]

(viii) When a man sells two things at the same price each and in this process his loss on first things is $x\%$ and gain on second things is $x\%$, then in such a type question, there is always a loss.

Loss % = $x\%$ of $x = \frac{x^2}{100} = \left(\frac{x}{10}\right)^2$.

and Loss $= \frac{2 \times \text{S.P.}}{\left(\frac{100}{x}\right)^2 - 1}$

(ix) An article is sold at a profit of $x\%$. Had it been sold for ₹ a some more, $y\%$ would have gained. Then, C.P. of an article =

$$\frac{\text{More gain} \times 100}{\text{Difference in percentage profit}}$$

(x) A dishonest shopkeeper prefers to sell goods at his cost price but uses a false weight of x grams for each kilogram. Then his gain per cent,

$$\text{gain \%} = \frac{\text{Error}}{\text{True value} - \text{Error}} \times 100$$

$$= \frac{1000 - x}{x} \times 100$$

or, gain % $= \frac{\text{True weight} - \text{False weight}}{\text{False weight}} \times 100$.

EXERCISE

1. Ashok bought 25 kg of rice at the rate of ₹ 6 per kg and 35 kg of rice at the rate of ₹ 7 per kg. He mixed the two and sold the mixture at the rate of ₹ 6.75 per kg. What was his gain or loss in the transaction?
A. ₹ 16 gain B. ₹ 16 loss
C. ₹ 10 gain D. None of these

2. A horse and a cow were sold for ₹ 12000 each. The horse was sold at a loss of 20% and the cow at a gain of 20%. The entire transaction resulted in
A. no loss no gain B. loss of ₹ 1000
C. gain of ₹ 1000 D. loss of ₹ 2000

3. Profit after selling a commodity for ₹ 425 is same as loss after selling it for ₹ 355. The cost of the commodity is :
A. ₹ 285 B. ₹ 390
C. ₹ 295 D. ₹ 400

4. Bhajan Singh purchased 120 reams of paper at ₹ 80 per ream. He spent ₹ 280 on transportation, paid octroi at the rate of 40 paise per ream and paid ₹ 72 to the coolie. If he wants to have a gain of 8%, what must be the selling price per ream?
A. ₹ 86 B. ₹ 86.48
C. ₹ 79 D. ₹ 90

5. Ram bought 4 dozen apples at ₹ 12 per dozen and 2 dozen at ₹ 16 per dozen. He sold all of them to earn 20%. At what price per dozen did he sell the apples?
A. ₹ 14.40 B. ₹ 16.00
C. ₹ 16.80 D. ₹ 16.20

6. Jimmy bought paper sheets for ₹ 7200 and spent ₹ 200 in transport. Paying ₹ 600 he had 330 boxes made, which he sold at ₹ 28 each. What is his profit percentage?
A. 15.5 B. 40
C. 50 D. None of these

7. A owns a house worth ₹ 10000. He sells it to B at a profit of 10% based on the worth of the house. B sells the house back to A at a loss of 10%. In this transaction A gets:
A. no profit no loss B. profit of ₹ 1000
C. profit of ₹ 1100 D. profit of ₹ 1200

8. At what price must Kantilal sell a mixture of 80 kg sugar at ₹ 6.75 per kg with 120 kg at ₹ 8 per kg to gain 20%?
A. ₹ 7.50 per kg B. ₹ 8.20 per kg
C. ₹ 8.35 per kg D. ₹ 9 per kg

9. Subhash purchased a taperecorder at $\frac{9}{10}$ of its selling price and sold it at 8% more than its S.P. His gain is:
A. 8% B. 10%
C. 18% D. 20%

10. A dealer marks his goods 20% above cost price. He then allows some discount on it and makes a profit of 8%. The rate of discount is :
A. 12% B. 10%
C. 6% D. 4%

11. A trader lists his articles 20% above C.P. and allows a discount of 10% on cash payment. His gain per cent is :
A. 10% B. 8%
C. 6% D. 4%

12. Tarun bought a T.V. with 20% discount on the labelled price. Had he bought it with 25% discount, he would have saved ₹ 500. At what price did he buy the T.V.?
A. ₹ 5000 B. ₹ 8000
C. ₹ 10000 D. ₹ 12000

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13. While selling a watch, a shopkeeper gives a discount of 5%. If he gives a discount of 7%, he earns ₹ 15 less as profit. The marked price of the watch is :
A. ₹ 697.50 B. ₹ 712.50
C. ₹ 787.50 D. None of these

14. Kabir buys an article with 25% discount on its marked price. He makes a profit of 10% by selling it at ₹ 660. The marked price is :
A. ₹ 600 B. ₹ 700
C. ₹ 800 D. ₹ 885

15. A person bought an article and sold it at a loss of 10%. If he had bought it for 20% less and sold it for ₹ 55 more, he would have had a profit of 40%. The C.P. of the article is :
A. ₹ 200 B. ₹ 225
C. ₹ 250 D. None of these

ANSWERS

1	2	3	4	5	6	7	8	9	10
C	B	B	D	B	A	C	D	D	B
11	**12**	**13**	**14**	**15**					
B	B	D	C	C					

EXPLANATORY ANSWERS

1. C.P. of 60 kg mixture = ₹ (25 × 6 + 35 × 7) = ₹ 395
S.P. of 60 kg mixtire = ₹ (60 × 6.75) = ₹ 405
∴ Gain = ₹ (405 – 395) = ₹ 10

2. Loss % = $\left(\frac{20}{10}\right)^2$ = $(2)^2$ = 4%
Total S.P. = ₹ 24000
and Total C.P. = ₹$\left(\frac{100}{96}\times 24000\right)$ = ₹ 25000
∴ Loss = ₹ (25000 – 24000) = ₹ 1000

3. Let C.P. = ₹ x, Then, $425 - x = x - 355$
⇒ $2x = 780$ ∴ x = ₹ 390

4. C.P. of 1 ream = $80 + \frac{280}{120}+\frac{72}{120}+0.40$
$= 80 + \frac{7}{3}+\frac{3}{5}+\frac{2}{5} =$ ₹ $\frac{250}{3}$
∴ S.P. of 1 ream = ₹$\left(\frac{108}{100}\times\frac{250}{3}\right)$ = ₹ 90

5. C.P. of 6 dozen apples = ₹ (12 × 4 + 16 × 2) = ₹ 80
∴ S.P. = ₹$\left(\frac{120}{100}\times 80\right)$ = ₹ 96
∴ S.P. per dozen = ₹$\left(\frac{96}{6}\right)$ = ₹ 16

6. C.P. of 1 box = $\frac{7200+200+600}{330}$ = ₹ $\frac{800}{33}$
Hence, Gain% = $\frac{28-\frac{800}{33}}{800/33}\times 100 = \frac{124}{800}\times 100 = 15.5\%$

7. Final C.P. for A = $\frac{110}{100}\times\frac{90}{100}\times$ ₹ 10000 = ₹ 9900
Hence, profit for A
= $\frac{10}{100}$ × ₹ 10,000 + ₹ (10,000 – 9900) = ₹ 1100

8. C.P. of 1 kg sugar = $\frac{80\times 6.75+120\times 8}{200}$ = ₹ 7.50
∴ S.P. of 1 kg = ₹$\left(\frac{120}{100}\times 7.50\right)$ = ₹ 9 per kg

9. Let S.P. = ₹ 100;
C.P. for Subhash = $\frac{9}{10}\times 100$ = ₹ 90 and S.P. = ₹ 108
Hence, gain % for Subhash = $\frac{108-90}{90}\times 100 = 20\%$

10. Let C.P. be ₹ 100; then Marked price = ₹ 120 and S.P. = ₹ 108
∴ Discount = $\left(\frac{12}{120}\times 100\right)\%$ = 10%

11. Let C.P. be ₹ 100
Then, marked price = ₹ 120
S.P. = ₹$\left(\frac{90}{100}\times 120\right)$ = ₹ 108
∴ Gain % = $\left(\frac{8}{100}\times 100\right)\%$ = 8%

12. Here, 5% = 500
∴ 100% = $\frac{500}{5}\times 100$ = ₹ 10,000
Hence, labelled price = ₹ 10,000
∴ S.P. = $\frac{80}{100}$ × ₹ 10,000 = ₹ 8000

13. Let the marked price = ₹ x
Then, $\frac{7x}{100}-\frac{5x}{100}=15 \Rightarrow \frac{x}{50}=15$ ∴ x = ₹ 750

14. C.P. = $\frac{100}{110}\times 660$ = ₹ 600
Hence, M.P. = $\frac{100}{75}\times 600$ = ₹ 800.

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Simple Interest

Interest is the money paid for the use of money borrowed, *i.e.*, extra money paid for using other's money is called *interest.*

The sum borrowed is called the principal. The sum of interest and principal is called the *Amount.*

If the interest on a certain sum borrowed for a certain period is reckoned uniformly, then it is called simple interest, denoted by S.I.

Thus, if A = Amount, P = Principal, I = Interest, T = Time (in year), R = Rate per cent per annum, then

(*a*) $I = \frac{P \times R \times T}{100}$ (*b*) $P = \frac{100 \times I}{R \times T}$

(*c*) $T = \frac{100 \times I}{P \times R}$ (*d*) $R = \frac{100 \times I}{P \times T}$

(*e*) $P = \frac{100\,A}{100 + RT}$ (*f*) A = P + I.

EXERCISE

1. If the simple interest on a certain sum of money at 6% per annum for 3 years is ₹ 90, the sum will be:
A. ₹ 500 B. ₹ 450
C. ₹ 525 D. ₹ 560

2. If the simple interest on ₹ 1 for 1 month is 1 paise, the rate per cent p.a. will be :
A. 10% B. 8%
C. 12% D. 6%

3. A sum of money doubles itself in 20 years. In how many years will it triple itself at the same rate of simple interest?
A. 30 years B. 50 years
C. 40 years D. 45 years

4. If the simple interest on ₹ 500 for 4 years is ₹ 40, find the rate per cent p.a.
A. 3½% B. 2%
C. 2½% D. 3%

5. After what time will the sum of ₹ 2000 become ₹ 2240 at 4% per annum simple interest?
A. 3 years B. 2 years
C. 5 years D. 4 years

6. The simple interest on a certain sum of money is $\frac{25}{64}$ of the sum and the number of years equals the rate per cent p.a. The rate per cent p.a. will be :
A. $7\frac{1}{2}\%$ B. $5\frac{1}{4}\%$
C. $6\frac{3}{4}\%$ D. $6\frac{1}{4}\%$

7. A sum of money amounts to ₹ 1150 in 3 years and to ₹ 1250 in 5 years at a certain rate per cent p.a. simple interest. The rate per cent p.a. will be :
A. 5% B. 8%
C. 7% D. 6%

8. The simple interest on a sum of ₹ 892 lent out at 6% p.a. for 8 months will be :
A. ₹ 36.68 B. ₹ 35.68
C. ₹ 48.58 D. ₹ 33.38

9. If the simple interest on a certain sum of money at 6% p.a. for 4½ years is ₹ 81, the sum will be:
A. ₹ 325 B. ₹ 225
C. ₹ 300 D. ₹ 340

10. A sum of ₹ 1850 lent out for 5 years at 3% p.a. simple interest will amount to:
A. ₹ 2227.75 B. ₹ 2127.50
C. ₹ 2137.50 D. ₹ 2086.50

11. A lent a sum of ₹ 1250 to B at a certain rate of interest for 3 years and a sum of ₹ 1500 to C at the same rate of interest for 2 years. If he was paid total ₹ 258.75 as interest in both cases, find the rate of interest at which money was lent by him.
A. $4\frac{1}{6}\%$ B. $6\frac{1}{4}\%$
C. $2\frac{1}{7}\%$ D. $3\frac{5}{6}\%$

12. A invested ₹ 5000 at a certain rate of simple interest and ₹ 4000 for the same period at 1% higher rate of interest. If the interest in both cases is same, the former rate of interest is :
A. 3% B. 4%
C. 6% D. 5%

13. A man lends ₹ 500 for 4 years and ₹ 600 for 3 years at a certain rate of simple interest. If he gets total ₹ 190 as interest in both cases, the rate per cent per annum is:
A. 8% B. 5%
C. 10% D. 4%

14. What annual instalment should be paid to clear the debt of ₹ 645 in 4 years at the rate of 5% p.a. simple interest?
A. ₹ 160 B. ₹ 185
C. ₹ 180 D. ₹ 190

15. If a certain sum of money at simple interest amounts to ₹ 1900 in 3 years and to ₹ 2050 in 5 years, the rate per cent per annum is:
A. 4½% B. 3½%
C. 2½% D. 5¼%

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ANSWERS

1	2	3	4	5	6	7	8	9	10
A	C	C	B	A	D	A	B	C	B
11	**12**	**13**	**14**	**15**					
D	B	B	C	A					

EXPLANATORY ANSWERS

1. $P = \frac{90 \times 100}{6 \times 3} = ₹\ 500$

2. Rate $= \frac{1 \times 100}{100 \times \frac{1}{12}} = 12\%.$

3. Let principal = ₹ x; Amount = ₹ $2x$;
then I = $2x - x$ = ₹ x

$\therefore$ R $= \frac{x \times 100}{x \times 20} = 5\%$

Again, if principal = ₹ x;
Amount = ₹ $3x$; then I = $3x - x$ = ₹ $2x$

Hence, T $= \frac{2x \times 100}{x \times 5} = 40$ years

4. Rate $= \frac{40 \times 100}{500 \times 4} = 2\%$

5. Here, I = 2240 − 2000 = ₹ 240

$\therefore$ T $= \frac{240 \times 100}{2000 \times 4} = 3$ years

6. Let, R = T = x; then

$\frac{25}{64}P = \frac{P \times x \times x}{100} \Rightarrow x^2 = \frac{25 \times 100}{64}$

$\therefore$ $x = \frac{5 \times 10}{8} = \frac{25}{4}$; R $= 6\frac{1}{4}\%$

7. Here, Simple interest for 2 years
= ₹ 1250 − ₹ 1150 = ₹ 100

$\therefore$ Simple interest for 3 years $= \frac{100 \times 3}{2} = ₹\ 150$

Hence, P = ₹ 1150 − ₹ 150 = ₹ 1000

$\therefore$ Rate $= \frac{50 \times 100}{1000 \times 1} = 5\%$

8. Here, I $= \frac{892 \times 6 \times \frac{2}{3}}{100} = ₹\ 35.68$

9. P $= \frac{81 \times 100 \times 2}{6 \times 9} = ₹\ 300$

10. I $= \frac{1850 \times 3 \times 5}{100} = ₹\ 277.50$

$\therefore$ Amount = ₹ 1850 + ₹ 277.50
= ₹ 2127.50

11. $\frac{1250 \times R \times 3}{100} + \frac{1500 \times R \times 2}{100} = 258.75$

$\Rightarrow$ 6750 R = 25875

$\therefore$ R $= \frac{25875}{6750} = \frac{23}{6} = 3\frac{5}{6}\%$

12. Here, $\frac{5000 \times R \times T}{100} = \frac{4000 \times (R+1) \times T}{100}$

$\Rightarrow$ 5R = 4R + 4 $\therefore$ R = 4%

13. Here, $\frac{500 \times R \times 4}{100} + \frac{600 \times R \times 3}{100} = 190$

$\Rightarrow$ 38R = 190

$\therefore$ R $= \frac{190}{38} = 5\%.$

14. Let annual instalment be ₹ x; then

$$x + \frac{x \times 3 \times 5}{100} + x + \frac{x \times 2 \times 5}{100} + x + \frac{x \times 1 \times 5}{100} + x = 645 + \frac{645 \times 4 \times 5}{100}$$

$\Rightarrow$ $4x + \frac{3x}{10} = 774 \Rightarrow \frac{43x}{10} = 774$

$\therefore$ $x = \frac{774 \times 10}{43} = ₹\ 180$

15. Simple interest for 2 years
= ₹ 2050 − ₹ 1900 = ₹ 150
$\therefore$ Simple interest for 1 year

= ₹ $\frac{150}{2}$ = ₹ 75

Since simple interest for 3 years
= ₹ 75 × 3 = ₹ 225
$\therefore$ Principal = ₹ 1900 − ₹ 225 = ₹ 1675

Hence, Rate $= \frac{75 \times 100}{1675 \times 1} = 4½\%$

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Compound Interest

In business transaction if interest as it becomes due is not paid to the lender but is added on to the principal, the money is said to be lent at *compound interest* and the total sum owed after a given time is called the amount at compound interest for that time.

After a certain period, the difference between the amount and the original principal is called the compound Interest (C.I.).

Some Important Formulae :

Let Principal = P, Time = n years

Rate = $r\%$ p.a.

then, the amount,

(a) when interest is compounded annually:

then, Amount = $P\left(1+\frac{r}{100}\right)^n$

(b) when interest is compounded half yearly:

then, Amount = $P\left(1+\frac{r/2}{100}\right)^{2n}$

(c) when interest is compounded quarterly :

then, Amount = $P\left(1+\frac{r/4}{100}\right)^{4n}$

(d) when time is fraction of a year, say $4\frac{1}{3}$ years,

then, Amount = $P\left(1+\frac{r}{100}\right)^4 \times \left(1+\frac{\frac{1}{3}r}{100}\right)$

(e) when rates are $r_1\%$, $r_2\%$ and $r_3\%$ for Ist, IInd and IIIrd year respectively; then,

Amount = $P\left(1+\frac{r_1}{100}\right)\left(1+\frac{r_2}{100}\right)\left(1+\frac{r_3}{100}\right)$

EXERCISE

1. What will be the compound interest on ₹ 8000 for 3 years at 5% p.a.?
A. ₹ 1361 B. ₹ 1261
C. ₹ 1260 D. ₹ 1250

2. What will be the amount if a sum of ₹ 2500 is invested for 1 year at 4% per annum compound interest, interest being compounded half-yearly?
A. ₹ 2625 B. ₹ 2601
C. ₹ 2830 D. ₹ 2901

3. Find the compound interest on ₹ 2560 for ½ year at 12½% per annum, interest payable quarterly.
A. ₹ 3720.50 B. ₹ 2722.50
C. ₹ 2752.50 D. ₹ 2250.50

4. After how many years will ₹ 3375 become ₹ 4096 at $6\frac{2}{3}\%$ per annum compound interest?
A. 4 years B. 2 years
C. 2½ years D. 3 years

5. A certain sum of money placed at compound interest amounts to ₹ 110 in 1 year and to ₹ 121 in 2 years. The rate of interest per annum is :
A. 5% B. 10%
C. 8% D. 4%

6. The present population of a city is 80,000. If the rate of growth is 5% per year, find its population after 3 years.
A. 88,100 B. 95,600
C. 92,610 D. 84,600

7. First year's interest on a sum of money placed at compound interest at the rate of 8% per annum is ₹ 72. What will be interest for the second year?
A. ₹ 77.76 B. ₹ 78.66
C. ₹ 85.66 D. ₹ 78.76

8. The difference between compound and simple interest on a certain sum of money for 2 years at 5% per annum is ₹ 21. Find the sum.
A. ₹ 7200 B. ₹ 8400
C. ₹ 9200 D. ₹ 8500

9. In how many years will a sum of ₹ 19200 placed at 10% per annum compound interest yield an interest of ₹ 4032?
A. 1½ years B. 2½ years
C. 2 years D. 3 years

10. The compound interest on a certain sum of money invested for 3 years at 5% per annum is ₹ 1891.50. What will be the simple interest on the same sum at the same rate for 2 years?
A. ₹ 1700 B. ₹ 1200
C. ₹ 1500 D. ₹ 2100

11. The simple interest on a sum of ₹ 4800 for 2 years is ₹ 768. What will be the compound interest on the same sum at the same rate and for the same period?
A. ₹ 798.72 B. ₹ 870.75
C. ₹ 920.69 D. ₹ 884.20

12. A sum of money lent out at a certain rate of simple interest amounts to ₹ 6600 in 2 years and to ₹ 6900 in 3 years. What will be the compound interest on the same sum of money if lent out at the same rate for 2 years?
A. ₹ 605 B. ₹ 715
C. ₹ 615 D. ₹ 595

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13. If the first year's interest on a certain sum of money placed at 5% p.a. compound interest is ₹ 1200, what will be the interest for the third year?
A. ₹ 1220 B. ₹ 1323
C. ₹ 1423 D. ₹ 1330

14. If a certain sum of money placed at compound interest amounts to ₹ 960 in 3 years and to ₹ 1000 in 4 years, find the rate of compound interest.
A. $4\frac{1}{6}\%$ B. $5\frac{1}{6}\%$
C. $2\frac{1}{3}\%$ D. 3%

15. What would be the compound interest on ₹ 3200 at 25% per annum for 3 years?
A. ₹ 2050 B. ₹ 2775
C. ₹ 3050 D. ₹ 3180

ANSWERS

1	2	3	4	5	6	7	8	9	10
B	B	B	D	B	C	A	B	C	B
11	**12**	**13**	**14**	**15**					
A	C	B	A	C					

EXPLANATORY ANSWERS

1. $\therefore$ C.I. $= 8000\left[\left(1+\frac{5}{100}\right)^3-1\right]$

$= 8000\left[\left(\frac{21}{20}\right)^3-1\right] = \frac{8000\times1261}{8000}$ = ₹ 1261

2. A $= 2500\left(1+\frac{2}{100}\right)^2 = 2500\left(\frac{51}{50}\right)^2 = \frac{2500\times51\times51}{50\times50}$

= ₹ 2601.

3. Amount $= 2560\left(1+\frac{25}{8\times100}\right)^2 = \frac{2560\times33\times33}{32\times32}$

= ₹ 2722.50

4. Here, $4096 = 3375\left(1+\frac{20}{3\times100}\right)^n$

$\Rightarrow \frac{4096}{3375} = \left(1+\frac{1}{15}\right)^n \Rightarrow \left(\frac{16}{15}\right)^3 = \left(\frac{16}{15}\right)^n$

$\therefore\ n = 3$ years

5. Here, simple interest of ₹ 110 for 1 year
= 121 – 110 = ₹ 11

Hence, rate $= \frac{11\times100}{110\times1} = 10\%$

6. Population of the city after 3 years

$= 80{,}000\left(1+\frac{5}{100}\right)^3 = 80{,}000\times\frac{21}{20}\times\frac{21}{20}\times\frac{21}{20} = 92610$

7. Second year's interest = 72 + 8% of 72

$= 72+\frac{72\times8}{100}$ = 72 + 5.76 = ₹ 77.76

8. Here, $P\left[\left(1+\frac{5}{100}\right)^2-1\right]-\frac{P\times5\times2}{100}=21$

$\Rightarrow P\left[\frac{441}{400}-1\right]-\frac{P}{10}=21$

$\Rightarrow P\left[\frac{41}{400}-\frac{1}{10}\right]=21 \Rightarrow P\times\frac{1}{400}=21$

$\therefore\ P = 21 \times 400 =$ ₹ 8400

9. Amount =₹ 19200 + ₹ 4032 = ₹ 23232

Now, $23232 = 19200\left(1+\frac{10}{100}\right)^n$

$\Rightarrow \frac{23232}{19200} = \left(\frac{11}{10}\right)^n \Rightarrow \frac{121}{100} = \left(\frac{11}{10}\right)^n$

$\Rightarrow \left(\frac{11}{10}\right)^2 = \left(\frac{11}{10}\right)^n$

$\therefore\ n = 2$ years

11. Rate $= \frac{768\times100}{4800\times2} = 8\%$

$\therefore$ C.I. $= 4800\left[\left(1+\frac{8}{100}\right)^2-1\right]$

$= 4800\left[\left(\frac{27}{25}\right)^2-1\right] = \frac{4800\times104}{625}$ = ₹ 798.72

13. Required interest

$= 1200\left(1+\frac{5}{100}\right)^2 = 1200\times\frac{21}{20}\times\frac{21}{20}$ = ₹ 1323

14. Here, simple interest of ₹ 960 for 1 year
= 1000 – 960 = ₹ 40

Hence, Rate $= \frac{40\times100}{960\times1} = \frac{25}{6} = 4\frac{1}{6}\%$

15. Compound interest

$= 3200\left[\left(1+\frac{25}{100}\right)^3-1\right] = 3200\left[\left(\frac{5}{4}\right)^3-1\right]$

$= \frac{3200\times61}{64}$ = ₹ 3050.

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CHAPTER 3

Ratio and Proportion

RATIO

In ratio we compare two quantities of the same kind and consider what multiple, part or parts one is of the other. In comparing 8 with 4, observe that it is 2 times 4. This comparison can be represented as $8 \div 4$ or $\frac{8}{4}$.

Hence, *ratio is that relation between two numbers which is expressed by the fraction, the numerator is which is the measure of the first quantity and denominator is the measure of the second quantity.*

If the terms of a ratio be multiplied or divided by the same quantity the value of the ratio remains unaltered.

Thus, 3 : 4 is the same as 9 : 12 and 9 : 12 is the same as 3 : 4.

PROPORTION

The equality of two ratio is called proportion.

Consider the two ratios:

Ist ratio	2nd ratio
5 : 15	7 : 21

Since, 5 is one-third of 15 and 7 is one-third of 21, the two ratios are equal. The equality of two ratios is called proportion and the numbers 5, 15, and 7, 21 are said to be in **proportion.**

The proportion may be written as 5 : 15 : : 7 : 21 (5 is to 15 as 7 is to 21)

$\Rightarrow \quad 5 : 15 = 7 : 21$

$\Rightarrow \quad \frac{5}{15} = \frac{7}{21}$

The numbers 5, 15, 7 and 21 are called the terms. 5 is the first term, 15 the second, 7 the third, and 21 the fourth.

The first and fourth terms, *i.e.*, 5 and 21 are called extremes (end terms), and the second and the third terms, *i.e.*, 15 and 7 are called the **means** (middle terms), 21 is called the fourth proportional.

Some Important Facts:

1. If a and b are two quantities, then

(a) Duplicate ratio of $a : b = a^2 : b^2$

(b) Sub-duplicate ratio of $a : b = \sqrt{a} : \sqrt{b}$

(c) Triplicate ratio of $a : b = a^3 : b^3$

(d) Sub-triplicate ratio $a : b = \sqrt[3]{a} : \sqrt[3]{b}$

(e) Inverse or reciprocal ratio of $a : b = \frac{1}{a} : \frac{1}{b}$

(f) Third proportional to *'a'* and *'b'* $= \frac{b^2}{a}$

2. If A : B = x : y and B : C = p : q, then

(a) A : C = $\frac{x \times p}{y \times q}$

(b) A : B : C = $px : py : qy$

3. In what *ratio* the two kinds of tea must be mixed together one at ₹ x per kg and another at ₹ y per kg, so that the mixture may cost ₹ z per kg?

$$\text{Ratio} = \frac{z - y}{x - z}$$

4. A grey hound persues a hare as takes J_1 leaps for every J_2 leaps of the hare. If K_1 leaps of the hound are equal to K_2 leaps of the hare, then the Ratio of speeds of the hound and hare is

$$\frac{J_2 \times K_1}{J_1 \times K_2}$$

5. The incomes of two persons are in the ratio of a : b and their expenditure are in the ratio of x : y. If the saving of each person is ₹ s, then income of each is ₹ $\frac{as(y-x)}{ay-bx}$ and ₹ $\frac{bs(y-x)}{ay-bx}$ respectively.

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6. In a mixture of z litre, the ratio of milk and water is $x : y$. If another p litres of water is added to the mixture, the ratio of milk and water in the resulting mixture $= \frac{xz}{yz + p(x + y)}$

7. There are four members a, b, c and d, then formula for

(a) What should be added to each of these numbers so that the remaining numbers may be proportional = $\frac{ad - bc}{(b + c) - (a + d)}$

(b) What should be subtracted from each of these numbers so that the remaining numbers may be proportional = $\frac{ad - bc}{(a + d) - (b + c)}$

8. In a mixture the ratio of milk and water is $a : b$. If in this mixture another K litre of water is added, then the ratio of milk and water in the resulting mixture becomes $a : m$. Then the quantity of milk in the original mixture $= \frac{ak}{m - b}$ and quantity of water = $\frac{bk}{m - b}$

EXERCISE

1. If A : B = 6 : 7 and B : C = 8 : 9, then A : B : C is:
A. 24 : 28 : 63 B. 48 : 28 : 63
C. 48 : 56 : 63 D. None of these

2. The sum of two numbers is 20 and their difference is $2\frac{1}{2}$. What is the ratio of the numbers?
A. 11 : 7 B. 9 : 11
C. 9 : 7 D. None of these

3. If 0.7 of one number is equal to 0.075 of another, what is the ratio of the two numbers?
A. 6 : 14 B. 3 : 28
C. 5 : 7 D. None of these

4. If 10% of x is the same as 20% of y, then $x : y$ is equal to :
A. 1 : 2 B. 2 : 1
C. 5 : 1 D. 10 : 1

5. Two numbers are in the ratio 3 : 5. If each number is increased by 10, the ratio becomes 5 : 7. The numbers are:
A. 3, 5 B. 7, 9
C. 13, 22 D. 15, 25

6. The mean proportional between 0.32 and 0.02 is:
A. 0.34 B. 0.3
C. 0.16 D. 0.08

7. The sum of three numbers is 98. If the ratio between the first and second be 2 : 3 and that between the second and third be 5 : 8, then what is the second number?
A. 20 B. 30
C. 10 D. 40

8. One man adds 3 litres of water to 12 litres of milk and another 4 litres of water to 10 litres of milk. What is the ratio of the strenghts of the milk in the two mixtures?
A. 15 : 25 B. 25 : 28
C. 28 : 25 D. None of these

9. ₹ 425 is divided among 4 men, 5 women and 6 boys such that the share of a man, a woman and a boy may be in the ratio of 9 : 8 : 4. What is the share of a woman?
A. ₹ 34 B. ₹ 24
C. ₹ 44 D. None of these

10. A vessel contains liquids P and Q in the ratio 5 : 3. If 6 litres of the mixture are removed and the same quantity of liquid q is added, the ratio becomes 3 : 5. What quantity does the vessel hold?
A. 40 litres B. 50 litres
C. 30 litres D. None of these

11. A bucket contains a mixture of two liquids P and Q in the proportion 7 : 5. If 9 litres of the mixture is replaced by 9 litres of liquid Q, then the ratio of the two liquid becomes 7 : 9. How much of the liquid P was there in the bucket?
A. 11 litres B. 21 litres
C. 31 litres D. None of these

12. Three glasses P, Q and R with their capacities in the ratio 2 : 3 : 4 are filled with a mixture of spirit and water. The ratio of spirit to water in P, Q and R is 1 : 5, 3 : 5 and 5 : 7 respectively. If the contents of these glasses are mixed together, what is the ratio of spirit to water in the mixture?
A. 14 : 27 B. 23 : 47
C. 25 : 47 D. None of these

13. A and B are two alloys of gold and copper prepared by mixing metals in proportions 7 : 2 and 7 : 11 respectively. If equal quantities of the alloys are melted to form a third alloy C, the proportion of gold and copper in C will be
A. 5 : 9 B. 5 : 7
C. 7 : 5 D. 9 : 5

14. Gold is 19 times as heavy as water and copper 9 times as heavy as water. The ratio in which these two metals be mixed so that the mixtures is 15 times as heavy as water is:
A. 1 : 2 B. 2 : 3
C. 3 : 2 D. 19 : 135

15. The contents of two vessels containing water and milk are in the ratio 1 : 2 and 2 : 5 are mixed in the ratio 1 : 4. The resulting mixture will have water and milk in the ratio:

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A. 21 : 54 B. 31 : 74
C. 27 : 74 D. None of these

16. One year ago, the ratio between Mahesh and Suresh's salaries was 3 : 5. The ratio of their individual salaries of last year and present year are 2 : 3 and 4 : 5 respectively. If their total salaries for the present year are ₹ 4300, what is the present salary of Mahesh?
A. ₹ 1800 B. ₹ 1900
C. ₹ 1600 D. None of these

17. The ratio of P's and Q's income last year was 3 : 4. The ratio of their own incomes of last year and this year is 4 : 5 and 2 : 3 respectively. If the total sum of their present income is ₹ 4160. What is the present income of P?
A. ₹ 1500 B. ₹ 1400
C. ₹ 1600 D. None of these

18. The monthly salary of A, B, C is in the proportion of 2 : 3 ; 5. If C's monthly salary is ₹ 1200 more than that of A, then B's annual salary is:
A. ₹ 14400 B. ₹ 24000
C. ₹ 1200 D. ₹ 2000

19. ₹ 1050 is divided among P, Q and R. The share of P is $\frac{2}{5}$ of the combined share of Q and R. Thus P gets:
A. ₹ 200 B. ₹ 300
C. ₹ 400 D. ₹ 420

20. The ratio between Sumit's and Prakash's age at present is 2 : 3. Sumit is 6 years younger than Prakash. The ratio of Sumit's age to Prakash's age after 6 years will be:
A. 1 : 2 B. 2 : 3
C. 3 : 4 D. 3 : 8

ANSWERS

1	2	3	4	5	6	7	8	9	10
C	C	B	B	D	D	B	C	A	A
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
B	C	C	C	B	A	C	C	B	C

EXPLANATORY ANSWERS

1. $A : B = 6 : 7$
$B : C = 8 : 9$
$\therefore \quad A : B : C = 6 \times 8 : 7 \times 8 : 7 \times 9 = 48 : 56 : 63$

2. Ratio $= \dfrac{20 + \frac{5}{2}}{20 - \frac{5}{2}} = \dfrac{22.5}{17.5} = \dfrac{225}{175} = \dfrac{9}{7} = 9 : 7$

3. We have, $0.7x = 0.075\ y$

$$\frac{x}{y} = \frac{0.075}{0.7} = \frac{75}{700} = \frac{3}{28} = 3 : 28$$

4. 10% of $x = 20\%$ of y

$$\Rightarrow \quad \frac{10}{100}x = \frac{20}{100}y$$

$$\therefore \quad \frac{x}{10} = \frac{y}{5} \Rightarrow \frac{x}{y} = \frac{10}{5} = \frac{2}{1} \Rightarrow x : y = 2 : 1$$

5. Let the number be $3x$ and $5x$.

Then, $\dfrac{3x+10}{5x+10} = \dfrac{5}{7} \Rightarrow 7(3x + 10) = 5(5x + 10)$

$\Rightarrow \quad 21x + 70 = 25x + 50 \Rightarrow 4x = 20 \Rightarrow x = 5$

So, the numbers are 15, 25.

6. Mean proportional $= \sqrt{0.32 \times 0.02} = \sqrt{0.0064} = 0.08$

7. The ratio among the three numbers is

$2 : 3$
$5 : 8$
and $10 : 15 : 24$

$\therefore$ The second number $= \dfrac{98}{10 + 15 + 24} \times 15 = 30$

8. Strength of milk in the first mixture $= \dfrac{12}{12+3} = \dfrac{12}{15}$

Strength of milk in the second mixture $= \dfrac{10}{10+4} = \dfrac{10}{14}$

$\therefore$ The ratio of their strengths $= \dfrac{12}{15} : \dfrac{10}{14}$

$= 12 \times 14 : 15 \times 10 = 28 : 25$

9. The ratio of shares of group of men, women and boys $= 9 \times 4 : 8 \times 5 : 4 \times 6 = 9 : 10 : 6$

$\therefore$ Share of 5 women $= \dfrac{425}{9 + 10 + 6} \times 10 = ₹\ 170$

$\therefore$ Share of 1 woman $= \dfrac{170}{5} = ₹\ 34$

10. Let the vessel contains $5x$ litres and $3x$ litres of liquid P and Q respectively. The removed quantity contains

$$\frac{16}{5+3} \times 5 = 10 \text{ litres of P}$$

and $16 - 10 = 6$ litres of Q.

Now, $(5x - 10) : (3x - 6 + 16) = 3 : 5$

$$\Rightarrow \quad \frac{5x-10}{3x+10} = \frac{3}{5} \Rightarrow 25x - 50 = 9x + 30$$

$$\Rightarrow \quad 16x = 80 \Rightarrow x = 5$$

$\therefore$ Vessel contains $8x = 8 \times 5 = 40$ litres.

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11. Let the two liquids P and Q are $7x$ litres and $5x$ litres repectively.

Now, when 9 litres of mixture are taken out, P remains

$$7x - 9\left(\frac{7}{7+5}\right) = 7x - \frac{9\times 7}{12} = \left(7x - \frac{21}{4}\right) \text{litres}$$

and Q remains

$$5x - 9\left(\frac{5}{7+5}\right) = 5x - \frac{9\times 5}{12} = \left(5x - \frac{15}{4}\right) \text{litres}$$

Now, when 9 litres of liquid Q are added,

$$\left(7x - \frac{21}{4}\right) : \left(5x - \frac{15}{4} + 9\right) = 7 : 9$$

$$\Rightarrow \quad \frac{7x - \frac{21}{4}}{5x - \frac{15}{4} + 9} = \frac{7}{9}$$

$$\Rightarrow \quad 63x - \frac{189}{4} = 35x + \frac{147}{4}$$

$$\Rightarrow \quad 28x = \frac{189}{4} + \frac{147}{4} = \frac{336}{4} = 84$$

$$\Rightarrow \quad x = \frac{84}{28} = 3 \Rightarrow 7x = 7 \times 3 = 21 \text{ litres.}$$

12. P : Q : R

2 : 3 : 4

Spirit : Water = 1 : 5, 3 : 5 and 5 : 7

When they are mixed, the ratio of spirit to water

$$= \left(2\times\frac{1}{1+5} + 3\times\frac{3}{3+5} + 4\times\frac{5}{5+7}\right) : \left(2\times\frac{5}{1+5} + 3\times\frac{5}{3+5} + 4\times\frac{7}{5+7}\right)$$

$$= \left(\frac{1}{3} + \frac{9}{8} + \frac{5}{3}\right) : \left(\frac{5}{3} + \frac{15}{8} + \frac{7}{3}\right) = \frac{25}{8} : \frac{47}{8} = 25 : 47$$

13. Gold in C $= \left(\frac{7}{9} + \frac{7}{18}\right) = \frac{21}{18} = \frac{7}{6}$

Copper in C $= \left(\frac{2}{9} + \frac{11}{18}\right) = \frac{15}{18} = \frac{5}{6}$

$\therefore$ Gold : Copper $= \frac{7}{6} : \frac{5}{6} = 7 : 5$

14. Let 1 gm of gold be mixed with x gm of copper to give $(1 + x)$ gm of mixture.

Now, $1G = 19w$

and $1C = 9w$

and mixture $= 15w$

Now, 1 gm gold + x gm copper = $(1 + x)$ gm mixture

$\therefore 19w + 9w \times x = (1 + x) \times 15w$

Thus, $4w = 6wx$

$$\Rightarrow \quad x = \frac{4w}{6w} = \frac{4}{6} = \frac{2}{3}$$

So, the required ratio is $1 : \frac{2}{3}$, *i.e.*, 3 : 2.

15.

	Water	***Milk***
Vessel I	$\frac{1}{3}$	$\frac{2}{3}$
Vessel II	$\frac{2}{7}$	$\frac{5}{7}$

From vessel I, $\frac{1}{5}$ is taken and from vessel II, $\frac{4}{5}$ is taken. Therefore, the ratio of water to milk in the new vessel

$$= \left(\frac{1}{3}\times\frac{1}{5} + \frac{2}{7}\times\frac{4}{5}\right) : \left(\frac{2}{3}\times\frac{1}{5} + \frac{5}{7}\times\frac{4}{5}\right)$$

$$= \left(\frac{1}{15} + \frac{8}{35}\right) : \left(\frac{2}{15} + \frac{20}{35}\right) = \frac{31}{105} : \frac{74}{105} = 31 : 74$$

16. The ratio of Mahesh's salary for the two years = 2 : 3

The ratio of Suresh's salary for the two years = 4 : 5

We have also given that the ratio of their salary during the last year = 3 : 5

Now, we change the antecedents (2 and 4) of the first two ratios so that the antecedents in the first becomes 3 (antecedent of the third ratio) and the antecedent in the second becomes 5 (consequent of the third ratio).

Thus, $2 : 3 = 3 : \frac{9}{2}$ and $4 : 5 = 4\left(\frac{5}{4}\right) : 5\left(\frac{5}{4}\right) = 5 : \frac{25}{4}$

Now, it is clear that the ratio of their salaries for the present year is $\frac{9}{2} : \frac{25}{4} = 18 : 25$

$\therefore$ The present salary of Mahesh

$$= \frac{4300}{18+25}\times 18 = ₹\ 1800$$

17. The ratio of present incomes

$$= 3\times\frac{5}{4} : 4\times\frac{3}{2} = \frac{15}{4} : \frac{12}{2} = 30 : 48 = 5 : 8$$

$\therefore$ P's present income $= \frac{4160}{5+8}\times 5 = ₹\ 1600$

18. Let the monthly salary of A, B, C be $2x$, $3x$ and $5x$

Then, $5x - 2x = 1200$

or, $3x = 1200$

$\therefore \quad x = 400$

B's monthly salary $= 3x = 3 \times 400 = ₹\ 1200$

19. P : (Q + R) = 2 : 5

$\therefore$ P's share $= ₹\left(1050\times\frac{2}{7}\right) = ₹\ 300$

20. Let their ages be $2x$ and $3x$ years.

$\Rightarrow \quad 3x - 2x = 6 \Rightarrow x = 6$

Sumit's age = 12 years

Prakash's age = 18 years

After 6 years, Sumit's age = 18 years and Prakash's age = 24 years

$\therefore$ Ratio of their ages = 18 : 24 = 3 : 4

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Algebra

Square Roots

☛ Points To Remember

- A number n is a perfect square number, if $n = m^2$
- A perfect square number is never negative.
- A square number never ends in 2, 3, 7 or 8.
- The number of zeros at the end of a perfect square is even.
- The square of an even number is even.
- The square of an odd number is odd.
- There are no natural number p and q such that $p^2 = 2q^2$.
- A number m is a square root of n, if $n = m \times m = m^2$. Positive square root of n is written as $\sqrt{n}$.
- If p and q are perfect squares ($q \neq 0$), then
  (*i*) $\sqrt{p \times q} = \sqrt{p} \times \sqrt{q}$
  (*ii*) $\sqrt{\frac{p}{q}} = \frac{\sqrt{p}}{\sqrt{q}}$
- A perfect squares leaves remainder 0 or 1 on division by 3.
  The following table gives the possible remainders for some other prime divisors.

Divisor	Possible Remainders
3	0, 1
5	0, 1, 4
7	0, 1, 2, 4
11	0, 1, 3, 4, 5, 9
13	0, 1, 3, 4, 9, 10, 12

- The unit's digit of the square of a natural number is the unit's digit of the square of the digit at unit's place of the given natural number.

Unit's digit of the number	Unit's digit of the square of the number
0	0
1 or 9	1
2 or 8	4
3 or 7	9
4 or 6	6
5	5

- For every natural number n,
  $(n + 1)^2 - n^2 = (n + 1) + n$
  e.g.; $9^2 - 8^2 = 9 + 8 = 17$
  $19^2 - 18^2 = 19 + 18 = 37$
- The square of a natural number n is equal to the sum of first n odd natural numbers.
  e.g.; $2^2 = 1 + 3$
  $4^2 = 1 + 3 + 5 + 7 = 16$
  n^2 = Sum of first n odd natural numbers.
- A triplet (m, n, p) of three natural numbers m, n and p is called a pythagorean triplet
  if $m^2 + n^2 = p^2$
- The square root of a perfect square number can be obtained by :
  (*i*) the prime factorization. (*ii*) the division method.
- If n is not a perfect square, then $\sqrt{n}$ is not a rational number.
- Squares of natural numbers having all digits 1 have a following pattern:
  $1^2 = 1$
  $11^2 = 1\ \mathbf{2}\ 1$
  $111^2 = 1\ 2\ \mathbf{3}\ 2\ 1$
  $1111^2 = 1\ 2\ 3\ \mathbf{4}\ 3\ 2\ 1$

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11111^2 = 1 2 3 4 **5** 4 3 2 1

111111^2 = 1 2 3 4 5 **6** 5 4 3 2 1

⋮ ⋮ ⋮

111111111^2 = 1 2 3 4 5 6 7 8 **9** 8 7 6 5 4 3 2 1

In this pattern the sum of the digits of every number on the right hand side is a perfect square at given below:

$1 + 2 + 1 = 4 = 2^2$

$1 + 2 + 3 + 2 + 1 = 9 = 3^2$

$1 + 2 + 3 + 4 + 3 + 2 + 1 = 16 = 4^2$

. . . . . .

$1 + 2 + 3 + 4 + 5 + 6 + 7 + 8 + 9 + 8 + 7 + 6 + 5 + 4 + 3 + 2 + 1 = 81 = 9^2$.

- Observe the following pattern

$11^2 = 121$

$101^2 = 10201$

$1001^2 = 1002001$

$10001^2 = 100020001$

- Observe the following pattern

$11^2 = 121$

$101^2 = 10201$

$10101^2 = 102030201$

$1010101^2 = 1020304030201$

$101010101^2 = 10203040504030201$

- **Short Cut Method to find Squares Column Method**

Using $(a + b)^2 = a^2 + 2ab + b^2$.

Make three columns: What is square of 86

$a = 8, b = 6$

Step	Column I (a^2)	Column II $2ab$	Column III b^2
I	$(8)^2 = 64$	$2 \times 8 \times 6 = 96$	$(6)^2 = 36$
II	64	96	3**6**
		+ 3	
		9**9**	
III	64	96	3**6**
	+ 9	+ 3	
	73	9**9**	

The bold digits give the required square $86^2 = 7396$.

Square Root

Square root of a given number is that number which is multiplied by itself is equal to the given number.
For example, square root of 81 is 9 because
$92 = 9 \times 9 = 81$.

Methods of Finding the square root

(*a*) **Prime Factorization Method**

(*i*) Prime Factorization Method

(*ii*) Group the Factors in Paris

(*iii*) Take one number from each pair of factors and then multiply them together.

Example: Find the square root of 4761?

Solution: $4761 = \underbrace{23 \times 23} \times \underbrace{3 \times 3}$

$\therefore \quad \sqrt{4761} = 23 \times 3 = 69.$

(*b*) **Method of Division:** This method is used when the number is large and the factors cannot be easily determined.

Example: Find the square root of 226576?

Solution:

476

4 226516

16

87 665

7 609

946 5676

6 5676

×

$\sqrt[2]{226576} = 476.$

EXERCISE

1. $\sqrt{53824}$ = ?

A. 202 B. 232

C. 242 D. 332

2. The value of $\sqrt{10+\sqrt{25+\sqrt{108+\sqrt{154+\sqrt{255}}}}}$ is:

A. 4 B. 6

C. 8 D. 10

3. Evaluate : $\sqrt{41-\sqrt{21+\sqrt{19-\sqrt{9}}}}$.

A. 3 B. 5

C. 6 D. 6.4

4. $\left(\frac{\sqrt{625}}{11} \times \frac{14}{\sqrt{25}} \times \frac{11}{\sqrt{196}}\right)$ is equal to:

A. 5

B. 6

C. 8

D. 11

5. If $x * y = x + y + \sqrt{xy}$, the value of 6*24 is:

A. 41 B. 42

C. 43 D. 44

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6. $\sqrt{\frac{25}{81}-\frac{1}{9}}$ = ?

A. $\frac{2}{3}$ B. $\frac{4}{9}$

C. $\frac{16}{81}$ D. $\frac{25}{81}$

7. The value of $\sqrt{0.01}+\sqrt{0.81}+\sqrt{1.21}+\sqrt{0.0009}$ is:

A. 2.03 B. 2.1

C. 2.11 D. 2.13

8. If $\sqrt{18225}$ = 135, then the value of

$\left(\sqrt{182.25}+\sqrt{1.8225}+\sqrt{0.018225}+\sqrt{0.00018225}\right)$ is:

A. 1.49985 B. 14.9985

C. 149.985 D. 1499.85

9. If $\sqrt{3^n}$ = 729, then the value of n is:

A. 6 B. 8

C. 10 D. 12

10. If $\sqrt{1+\frac{x}{169}}=\frac{14}{13}$, then x is equal to:

A. 1 B. 13

C. 27 D. None of these

11. If $\sqrt{1+\frac{55}{729}}=1+\frac{x}{27}$, then the value of x is:

A. 1 B. 3

C. 5 D. 7

12. The value of $\frac{\sqrt{80}-\sqrt{112}}{\sqrt{45}-\sqrt{63}}$ is:

A. $\frac{3}{4}$ B. $1\frac{1}{3}$

C. $1\frac{7}{9}$ D. $1\frac{3}{4}$

13. Given $\sqrt{2}=1.414$. The value of

$\sqrt{8}+2\sqrt{32}-3\sqrt{128}+4\sqrt{50}$ is:

A. 8.426 B. 8.484

C. 8.526 D. 8.876

14. $\sqrt{\frac{0.081\times0.324\times4.624}{1.5625\times0.0289\times72.9\times64}}$ is equal to:

A. 0.024 B. 0.24

C. 2.4 D. 24

15. The value of $\sqrt{\frac{(0.03)^2+(0.21)^2+(0.065)^2}{(0.003)^2+(0.021)^2+(0.0065)^2}}$ is:

A. 0.1 B. 10

C. 10^2 D. 10^3

16. The square root of $\left(7+3\sqrt{5}\right)\left(7-3\sqrt{5}\right)$ is:

A. $\sqrt{5}$ B. 2

C. 4 D. $3\sqrt{5}$

17. $\left(\sqrt{3}-\frac{1}{\sqrt{3}}\right)^2$ simplifies to:

A. $\frac{3}{4}$ B. $\frac{4}{\sqrt{3}}$

C. $\frac{4}{3}$ D. None of these

18. $\left(\sqrt{2}+\frac{1}{\sqrt{2}}\right)^2$ is equal to :

A. $2\frac{1}{2}$ B. $3\frac{1}{2}$

C. $4\frac{1}{2}$ D. $5\frac{1}{2}$

19. If $3a = 4b = 6c$ and $a + b + c = 27\sqrt{29}$, then $\sqrt{a^2+b^2+c^2}$ is:

A. $3\sqrt{29}$

B. 81

C. 87

D. None of these

20. The square root of $0.\overline{4}$ is:

A. $0.\overline{6}$ B. $0.\overline{7}$

C. $0.\overline{8}$ D. $0.\overline{9}$

ANSWERS

1	2	3	4	5	6	7	8	9	10
B	A	C	A	B	B	D	B	D	C
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
A	B	B	A	B	B	C	C	C	A

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EXPLANATORY ANSWERS

1.
2	$\overline{5}\,\overline{3}\,\overline{8}\,\overline{2}\,\overline{4}$ (232
	4
43	138
	129
462	924
	924
	×

$\therefore \sqrt{53824} = 232.$

2. Given exp. $= \sqrt{10+\sqrt{25+\sqrt{108+\sqrt{154+15}}}}$

$= \sqrt{10+\sqrt{25+\sqrt{108+\sqrt{169}}}}$

$= \sqrt{10+\sqrt{25+\sqrt{108+13}}} = \sqrt{10+\sqrt{25+\sqrt{121}}}$

$= \sqrt{10+\sqrt{25+11}} = \sqrt{10+\sqrt{36}}$

$= \sqrt{10+6} = \sqrt{16} = 4$

3. Given exp. $= \sqrt{41-\sqrt{21+\sqrt{19-3}}}$

$= \sqrt{41-\sqrt{21+\sqrt{16}}} = \sqrt{41-\sqrt{21+4}}$

$= \sqrt{41-\sqrt{25}} = \sqrt{41-5} = \sqrt{36} = 6$

4. Given exp. $= \frac{25}{11}\times\frac{14}{5}\times\frac{11}{14} = 5$

5. $6*24 = 6 + 24 + \sqrt{6\times 24} = 30 + \sqrt{144} = 30 + 12 = 42$

6. $\sqrt{\frac{25}{81}-\frac{1}{9}} = \sqrt{\frac{25-9}{81}} = \sqrt{\frac{16}{81}} = \frac{\sqrt{16}}{\sqrt{81}} = \frac{4}{9}$

7. Given exp.

$= \sqrt{\frac{1}{100}}+\sqrt{\frac{81}{100}}+\sqrt{\frac{121}{100}}+\sqrt{\frac{9}{10000}}$

$= \frac{1}{10}+\frac{9}{10}+\frac{11}{10}+\frac{3}{100}$

$= 0.1 + 0.9 + 1.1 + 0.03 = 2.13$

8. Given exp.

$= \sqrt{\frac{18225}{10^2}}+\sqrt{\frac{18225}{10^4}}+\sqrt{\frac{18225}{10^6}}+\sqrt{\frac{18225}{10^8}}$

$= \sqrt{\frac{18225}{10}}+\sqrt{\frac{18225}{10^2}}+\sqrt{\frac{18225}{10^3}}+\sqrt{\frac{18225}{10^4}}$

$= \frac{135}{10}+\frac{135}{100}+\frac{135}{1000}+\frac{135}{10000}$

$= 13.5 + 1.35 + 0.135 + 0.0135 = 14.9985$

9. $\sqrt{3^n} = 729 = 3^6$

$\Leftrightarrow \left(\sqrt{3^n}\right)^2 = (3^6)^2$

$\Leftrightarrow 3^n = 3^{12}$

$\Leftrightarrow n = 12$

10. $\sqrt{1+\frac{x}{169}} = \frac{14}{13} \Rightarrow 1+\frac{x}{169} = \frac{196}{169}$

$\Rightarrow \frac{x}{169} = \left(\frac{196}{169}-1\right) = \frac{27}{169}$

$\Rightarrow x = 27.$

11. $\sqrt{1+\frac{55}{729}} = 1+\frac{x}{27}$

$\Rightarrow \sqrt{\frac{784}{729}} = \frac{27+x}{27}$

$\Rightarrow \frac{28}{27} = \frac{27+x}{27}$

$\Rightarrow 27 + x = 28 \Rightarrow x = 1$

12. $\frac{\sqrt{80}-\sqrt{112}}{\sqrt{45}-\sqrt{63}} = \frac{\sqrt{16\times 5}-\sqrt{16\times 7}}{\sqrt{9\times 5}-\sqrt{9\times 7}}$

$= \frac{4\sqrt{5}-4\sqrt{7}}{3\sqrt{5}-3\sqrt{7}} = \frac{4\left(\sqrt{5}-\sqrt{7}\right)}{3\left(\sqrt{5}-\sqrt{7}\right)} = \frac{4}{3} = 1\frac{1}{3}$

13. Given exp.

$= \sqrt{4\times 2}+2\sqrt{16\times 2}-3\sqrt{64\times 2}+4\sqrt{25\times 2}$

$= 2\sqrt{2}+8\sqrt{2}-24\sqrt{2}+20\sqrt{2}$

$= 6\sqrt{2} = 6 \times 1.414 = 8.484$

14. Given exp. $= \sqrt{\frac{81\times 324\times 4624}{15625\times 289\times 729\times 64}}$

$= \frac{9\times 18\times 68}{125\times 17\times 27\times 8} = \frac{3}{125} = 0.024$

15. Given exp. $= \sqrt{\frac{(0.03)^2+(0.21)^2+(0.065)^2}{\left(\frac{0.03}{10}\right)^2+\left(\frac{0.21}{10}\right)^2+\left(\frac{0.065}{10}\right)^2}}$

$= \sqrt{\frac{100\,[(0.03)^2+(0.21)^2+(0.065)^2}{(0.03)^2+(0.21)^2+(0.065)^2}}$

$= \sqrt{100} = 10$

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16. $\sqrt{(7+3\sqrt{5})(7-3\sqrt{5})} = \sqrt{(7)^2-(3\sqrt{5})^2}$

$= \sqrt{49-45} = \sqrt{4} = 2$

17. $\left(\sqrt{3}-\frac{1}{\sqrt{3}}\right)^2 = \left(\sqrt{3}\right)^2+\left(\frac{1}{\sqrt{3}}\right)^2-2\times\sqrt{3}\times\frac{1}{\sqrt{3}}$

$= 3+\frac{1}{3}-2 = 1+\frac{1}{3} = \frac{4}{3}$

18. $\left(\sqrt{2}+\frac{1}{\sqrt{2}}\right)^2 = \left(\sqrt{2}\right)^2+\left(\frac{1}{\sqrt{2}}\right)^2+2\times\sqrt{2}\times\frac{1}{\sqrt{2}}$

$= 2+\frac{1}{2}+2 = 4+\frac{1}{2} = 4\frac{1}{2}$

19. $4b = 6c \Rightarrow b = \frac{3}{2}c$ and $3a = 4b$

$\Rightarrow \quad a = \frac{4}{3}b = \frac{4}{3}\left(\frac{3}{2}c\right) = 2c$

$a + b + c = 27\sqrt{29}$

$2c+\frac{3}{2}c+c = 27\sqrt{29}$

$\Rightarrow \quad \frac{9}{2}c = 27\sqrt{29}$

$\Rightarrow \quad c = 6\sqrt{29}$

$\therefore \sqrt{a^2+b^2+c^2}$

$= \sqrt{(a+b+c)-2(ab+bc+ca)}$

$= \sqrt{\left(27\sqrt{29}\right)^2-2\left(2c\times\frac{3}{2}c+\frac{3}{2}c\times c+c\times 2c\right)}$

$= \sqrt{(729\times 29)-2\left(3c^2+\frac{3}{2}c^2+2c^2\right)}$

$= \sqrt{(729\times 29)-2\times\frac{13}{2}c^2}$

$= \sqrt{(729\times 29)-13\times\left(6\sqrt{29}\right)^2}$

$= \sqrt{29(729-468)}$

$= \sqrt{29\times 261} = \sqrt{29\times 29\times 9}$

$= 29 \times 3 = 87$

20. $\sqrt{0.\overline{4}} = \sqrt{\frac{4}{9}} = \frac{2}{3} = 0.666.... = 0.\overline{6}$.

Basic Algebraic Identities of School Algebra & Elementary Surds

Algebric Identies

Some Important Formula

(*i*) $(a + b)^2 = a^2 + 2ab + b^2$

(*ii*) $(a - b)^2 = a^2 - 2ab + b^2$

(*iii*) $a^2 - b^2 = (a - b)(a + b)$

(*iv*) $(a + b + c)^2 = a^2 + b^2 + c^2 + 2ab + 2bc + 2ca$

(*v*) $(a + b - c)^2 = a^2 + b^2 + c^2 + 2ab - 2bc - 2ca$

(*vi*) $(a - b + c)^2 = a^2 + b^2 + c^2 - 2ab - 2bc + 2ca$

(*vii*) $(-a + b + c)^2 = a^2 + b^2 + c^2 - 2ab + 2bc - 2ca$

(*viii*) $(a + b)^3 = a^3 + b^3 + 3ab(a + b)$ or

$= a^3 + b^3 + 3a^2b + 3ab^2$

(*ix*) $(a - b)^3 = a^3 - b^3 - 3ab\ (a - b)$ or

$= a^3 - b^3 - 3a^2b + 3ab^2$

(*x*) $a^3 + b^3 = (a + b)\ (a^2 + b^2 - ab)$ or

$= (a + b)^3 - 3ab(a + b)$

(*xi*) $a^3 - b^3 = (a - b)\ (a^2 + b^2 + ab)$ or

$= (a - b)^3 + 3ab\ (a - b)$

(*xii*) $a^3 + b^3 + c^3 - 3abc$

$= (a + b + c)(a^2 + b^2 + c^2 - ab - bc - ca)$

If $a + b + c = 0$

$a^3 + b^3 + c^3 = 3abc$

(*xiii*) $(x + a)\ (x + b) = x^2 + (a + b)x + ab$

(*xiv*) $(a + b)^2 + (a - b)^2 = 2(a^2 + b^2)$

(*xv*) $(a + b)^2 - (a - b)^2 = 4ab$

(*xvi*) $(a + b)^3 + (a - b)^3 = 2(a^3 + 3ab^2)$

(*xvii*) $(a + b)^3 - (a - b)^3 = (2(b^3 + 3a^2b)$

(*xviii*) If $x+\frac{1}{x} = t$ Then, $x^2+\frac{1}{x^2} = t^2-2$

(*xix*) If $x-\frac{1}{x} = t$ Then, $x^2+\frac{1}{x^2} = t^2+2$

(*xx*) $x^3+\frac{1}{x^3} = \left(x+\frac{1}{x}\right)^3-3\left(x+\frac{1}{x}\right)$

(*xxi*) $x^2-\frac{1}{x^3} = \left(x-\frac{1}{x}\right)^3+3\left(x-\frac{1}{x}\right)$

(*xxii*) $x+\frac{1}{x} = \sqrt{x^2+\frac{1}{x^2}+2}$

(*xxiii*) $x-\frac{1}{x} = \sqrt{x^2+\frac{1}{x^2}-2}$

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Factorization of Algebraic Expressions

Factorization : The process of writing an algebraic expression as the product of two or more algebraic expressions is called factorization.

Factors : The algebraic expressions that may be multiplied to obtain the given algebraic expressions are called factors of the given expression.

Factor Theorem : If $f(x)$ is completely divisible by $(x - a)$ then $f(a) = 0$, $(x - a)$ is called factor of $f(x)$, if and only if $f(a) = 0$

Remainder Theorem : If an expression $f(x)$ is divided by $(x - a)$ then the remainder is $f(a)$.

e.g., $f(x) = ax^3 + bx + cx + d$

$f(a) = a \cdot a^3 + b \cdot a + c \cdot a + d$ is known as remainder of the given polynomials.

Surds

Given a number, it is not always possible to find some whole number which when multiplied by itself will give the given number. In other words all given numbers are not perfect square numbers. For example, square root of 9, *i.e.,* $\sqrt{9}$ is 3, which is a whole number. But square root of 15, *i.e.,* $\sqrt{15}$ = 3.873, which is not a whole number.

Hence square roots of natural numbers which are not perfect squares are not rational numbers. These are irrational numbers and are called **Surds**.

For example, $\sqrt{3}$, $\sqrt{7}$, $2+\sqrt{11}$, $4+\sqrt{13}$ ..... etc. are Surds.

Given below are a few formulas which are quite helpful in solving the problems related to surds:

1. $\sqrt{a} \times \sqrt{a} = a$

2. $\sqrt{a} \times \sqrt{b} = \sqrt{ab}$

3. $\left(\sqrt{a}+\sqrt{b}\right)^2 = a + b + 2\sqrt{ab}$

4. $\left(\sqrt{a}-\sqrt{b}\right)^2 = a + b - 2\sqrt{ab}$

5. $x\sqrt{a} + x\sqrt{b} = x\left(\sqrt{a}+\sqrt{b}\right)$

6. $\dfrac{1}{\sqrt{a}+\sqrt{b}} = \dfrac{1}{\sqrt{a}+\sqrt{b}} \times \dfrac{\sqrt{a}-\sqrt{b}}{\sqrt{a}-\sqrt{b}} = \dfrac{\sqrt{a}-\sqrt{b}}{a-b}$

7. $\dfrac{1}{\sqrt{a}-\sqrt{b}} = \dfrac{1}{\sqrt{a}-\sqrt{b}} \times \dfrac{\sqrt{a}+\sqrt{b}}{\sqrt{a}+\sqrt{b}} = \dfrac{\sqrt{a}+\sqrt{b}}{a-b}$

8. $a + \sqrt{b} = c + \sqrt{d} \Rightarrow a = c$ and $b = d$

9. $\sqrt{2}$ = 1.41421, $\sqrt{3}$ = 1.73205, $\sqrt{5}$ = 2.23607, $\sqrt{6}$ = 2.4494 $\sqrt{7}$ = 2.64575, $\sqrt{8}$ = 2.82842, $\sqrt{10}$ = 3.16227, $\sqrt{11}$ = 3.31662

EXERCISE

1. $(28)^3 + (-15)^3 + (-13)^3$ = ?
A. 16380 B. 16250
C. 16420 D. 16280

2. If $x+\dfrac{1}{x}$ = 5, What is the value of $x^3+\dfrac{1}{x^3}$:
A. 120 B. 210
C. 110 D. 105

3. If $x^2+\dfrac{1}{x^2}=83$, what is the value of $x^3-\dfrac{1}{x^3}$ = ?
A. 756 B. 754
C. 856 D. 932

4. $23^3 - 17^3$ = ?
A. 7254 B. 7153
C. 7271 D. 7154

5. If $x + \dfrac{1}{x}$ = 15, then the value of $x^2 + \dfrac{1}{x^2}$ will be:
A. 228 B. 230
C. 323 D. 223

6. If x = 12 and y = 4, the value of $(x+y)^{x/y}$ will be:
A. 4096 B. 3896
C. 4196 D. 5086

7. If $x + y = 2z$, then the value of $\left(\dfrac{x}{x-z}+\dfrac{z}{y-z}\right)$ will be:
A. 1 B. 4
C. 3/2 D. 2

8. If $x + y + z = 0$, then the value of $\dfrac{(x+y)(y+z)(z+x)}{xyz}$ will be:
A. –3 B. –2
C. 0 D. –1

9. If $x + \dfrac{1}{x}$ = 3, the value of $x^4 + \dfrac{1}{x^4}$ will be:
A. 49 B. 47
C. 37 D. 42

10. If $\left(x+\dfrac{1}{x}\right)^2 = 0$, then the value of $\left(x^2+\dfrac{1}{x^2}\right)$ will be:
A. 1 B. –1
C. 2 D. –2

11. If $\left(a+\dfrac{2}{a}\right)$ = 3, then the value of $\left(a-\dfrac{2}{a}\right)$ will be:
A. ± 4 B. ± 5
C. ± 2 D. ± 1

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12. If $\sqrt{a}+\frac{1}{\sqrt{a}} = 4$, then the value of $a^2 + \frac{1}{a^2}$ will be:
A. 194 B. 199
C. 178 D. 192

13. Factors of $x^2 - 25$ are:
A. $(x - 1)(x - 25)$
B. $(x + 25)(x - 1)$
C. $(x + 5)(x - 5)$
D. $(x - 5)(x - 5)$

14. Square of $\left(x-\frac{1}{x}\right)$ will be
A. $x^2 - 2 - \frac{1}{x^2}$ B. $x^2 - 2 + \frac{1}{x^2}$
C. $x^2 - 4 - \frac{1}{x^2}$ D. $x^2 - 2 + \frac{1}{x}$

15. Factors of $36 - 9x^2$ will be:
A. $(6 + 3x)(6 - 3x)$ B. $(3x - 6)(6 - 3x)$
C. $(3x + 6)(3x - 6)$ D. $(12x - 3x)(3 + 3x)$

ANSWERS

1	2	3	4	5	6	7	8	9	10
A	C	A	A	D	A	A	D	B	D
11	**12**	**13**	**14**	**15**					
D	A	C	B	A					

EXPLANATORY ANSWERS

1. Let $a = 28$, $b = -15$ and $c = -13$. Then
$a + b + c = 28 - 15 - 13 = 0$
$a^3 + b^3 + c^3 = 3abc$
$(28)^3 + (-15)^3 + (-13)^3 = 3 \times 28 \times (-15) \times (-13)$
$= 16380$

2. $x^3+\frac{1}{x^3} = \left(x+\frac{1}{x}\right)^3 - 3\left(x+\frac{1}{x}\right)$
$= (5)^3 - 3 \times 5 = 125 - 15 = 110.$

3. If $x^2+\frac{1}{x^2}=83$, what is the value of $x^3-\frac{1}{x^3}$ = ?

$\left(x-\frac{1}{x}\right)^2 = x^2+\frac{1}{x^2}-2$

$x-\frac{1}{x} = \sqrt{83-2}=\sqrt{81}$

$x-\frac{1}{x} = 9$

$\therefore \left(x^3-\frac{1}{x^3}\right) = \left(x-\frac{1}{x}\right)^3+3\left(x-\frac{1}{x}\right)$
$= (9)^3 + 3 \times 9 = 729 + 27 = 756$

4. $23^3 - 17^3 = (20 + 3)^3 - (20 - 3)^3 = 2(3^3 + 3 \times 20^2 \times 3)$
$[\because (a + b)^3 - (a - b)^3 = 2(b^3 + 3a^2b)]$
$= 2(27 + 3600) = 54 + 7200 = 7254$

5. $\because x+\frac{1}{x}=15 \Rightarrow \left(x+\frac{1}{x}\right)^2 = (15)^2$

$\Rightarrow x^2+\frac{1}{x^2}+2.x\frac{1}{x} = 225$

$\therefore x^2+\frac{1}{x^2} = 225 - 2 = 223.$

6. $(x+y)^{x/y} = (12+4)^{12/4} = (16)^3 = 4096.$
$[\because x = 12, y = 4]$

7. $\because x + y = 2z \Rightarrow x - z = z - y = -(y - z)$

$\therefore \frac{x}{x-z}+\frac{z}{y-z}=\frac{x}{-(y-z)}+\frac{z}{y-z}=\frac{z-x}{y-z} = 1.$
$[\because x - z = z - y]$

8. $\because$ $x + y + z = 0 \Rightarrow x + y = -z$
$x + y + z = 0 \Rightarrow y + z = -x$
and $x + y + z = 0 \Rightarrow z + x = -y$

$\therefore \frac{(x+y)(y+z)(z+x)}{xyz} = \frac{(-z)(-x)(-y)}{xyz}$
$= -1.$

9. $\because x+\frac{1}{x}=3 \Rightarrow \left(x+\frac{1}{x}\right)^2 = (3)^2$

$\Rightarrow x^2+\frac{1}{x^2}+2.x.\frac{1}{x} = 9$

$\Rightarrow x^2+\frac{1}{x^2} = 9 - 2 = 7$

$\because x^2+\frac{1}{x^2} = 7 \Rightarrow \left(x^2+\frac{1}{x^2}\right)^2 = (7)^2$

$\Rightarrow x^4+\frac{1}{x^4}+2.x^2.\frac{1}{x^2} = 49$

$\therefore x^4+\frac{1}{x^4} = 49 - 2 = 47.$

10. $\left(x+\frac{1}{x}\right)^2 = 0 \Rightarrow x^2+\frac{1}{x^2}+2x.\frac{1}{x} = 0$

$\Rightarrow x^2+\frac{1}{x^2} = -2.$

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11. $\because \quad \left(a-\frac{2}{a}\right)^2 = \left(a+\frac{2}{a}\right)^2 - 4.a.\frac{2}{a} = (3)^2 - 8 = 9 - 8 = 1$

$\therefore \quad \left(a-\frac{2}{a}\right) = \pm\sqrt{1} = \pm 1.$

12. $\because \quad \sqrt{a}+\frac{1}{\sqrt{a}} = 4 \Rightarrow \left(\sqrt{a}+\frac{1}{\sqrt{a}}\right)^2 = (4)^2$

$\Rightarrow a + \frac{1}{a} + 2.\sqrt{a}.\frac{1}{\sqrt{a}} = 16 \because \left(a+\frac{1}{a}\right) = 14$

$\Rightarrow \left(a+\frac{1}{a}\right)^2 = (14)^2 \Rightarrow a^2 + \frac{1}{a^2} + 2.a.\frac{1}{a} = 196$

$\therefore \quad a^2 + \frac{1}{a^2} = 196 - 2 = 194.$

13. $x^2 - 25 = (x)^2 - (5)^2$,
[which is of the form $a^2 - b^2$]
$= (x + 5)(x - 5)$.

14. According to question:

Square of $\left(x-\frac{1}{x}\right) = \left(x-\frac{1}{x}\right)^2$

$= x^2 - 2.x.\frac{1}{x} + \left(\frac{1}{x}\right)^2$

$= x^2 - 2 + \frac{1}{x^2}.$

15. $36 - 9x^2 = (6)^2 - (3x)^2$ [which is of the form $a^2 - b^2$]
$= (6 + 3x)(6 - 3x)$.

Graphs of Linear Equations

Linear Equation in One Variable

Definition: A linear equation in one variable is an equation of the form $ax + b = 0$ or, $ax = c$ where, a, b, c are real numbers, $a \neq 0$ and x is a variable. Its graph is a straight line.

(i) If equation is on X-axis, then Y = 0

(ii) If equation is on Y-axis, then X = 0

Linear Equation in Two Variables

Definition: An equation of the form $ax + by + c = 0$ or, $ax + by = c$ where, a, b, c are real numbers, $a \neq 0$, $b \neq 0$ and x, y are variables, is called a linear equation in two variables.

For example: (i) $2x + 3y = 12$ (ii) $x + 2y = 8$

The System of Equations

$a_1x + b_1y + c_1 = 0$ and $a_2x + b_2y + c_2 = 0$ may be either unique solution or no solution or infinitely many solutions.

Unique solution is known as consistent or not parallel. No solution is known as inconsistent or parallel, while many solutions are known as coincident or dependent.

(a) **For unique solution:** $\frac{a_1}{a_2} \neq \frac{b_1}{b_2}$

(b) **For no solution:** $\frac{a_1}{a_2} = \frac{b_1}{b_2} \neq \frac{c_1}{c_2}$

(c) **For many solutions:** $\frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{c_1}{c_2}$

Graph of linear equations

Graph of a linear equation in two variables x and y *i.e.,* the graph of the equation of the form

$ax + by + c = 0$, $a \neq 0$, b $\neq 0$

we consider the equation,

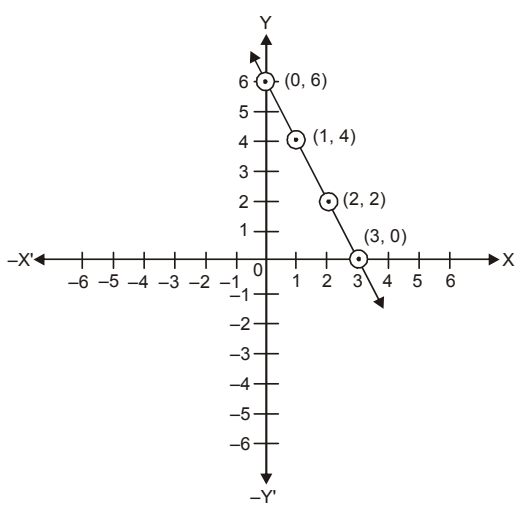
$2x + y = 6$

then, $y = 6 - 2x$

We find different values of this equation

x	0	1	2	3
y	6	4	2	0

Now, we plot these points (x, y) on a graph paper and then join these points



Hence, the line l is called the graph of the equation

$2x + y = 6$

Example 1: Draw the graph:

(i) $x = 2$, (ii) $y = 3$, (iii) $y = 0$

Solution: (i) The given equation, $x = 2$ does not contain y

Table of values

x	2	2	2	fixed
y	1	3	4	any value

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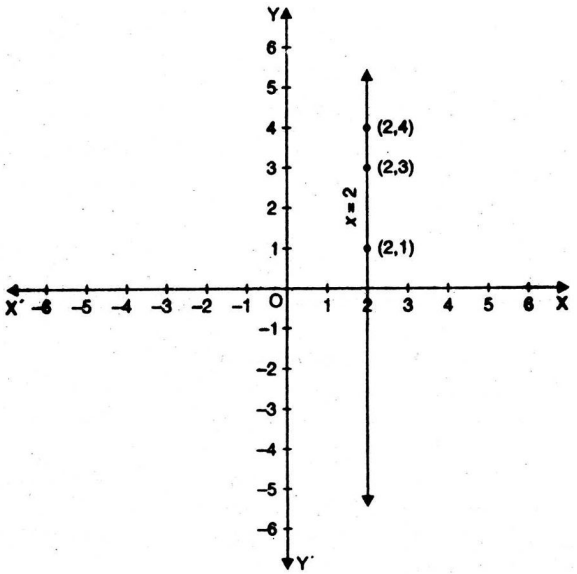
ploting the points (2, 1), (2, 3) and (2, 4) and joining them

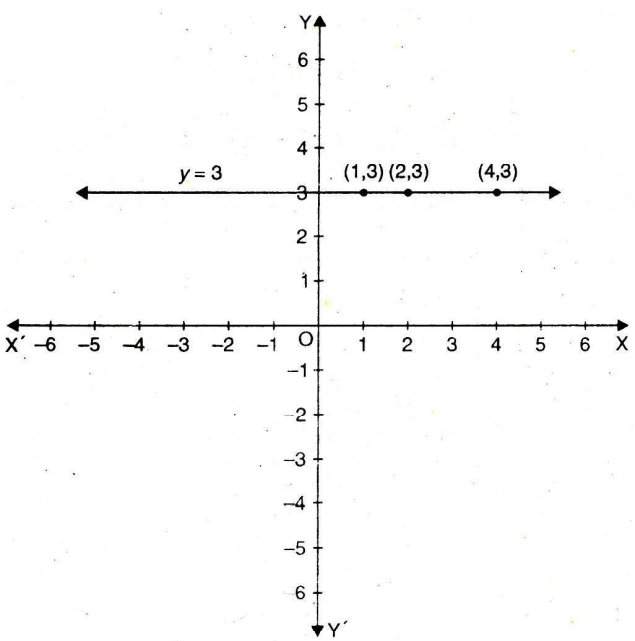


Hence, the graph of the given equation is a line parallel to y-axis

(*ii*) The given equation $y = 3$ does not contain x

Table of values

x	1	2	4	any value
y	3	3	3	fixed

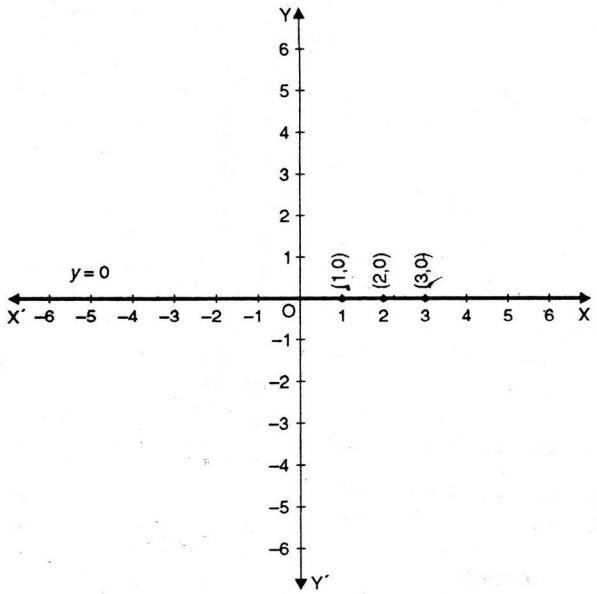


Hence, the graph of the given equation is a line parallel to x-axis.

(*iii*) The given equation is $y = 0$

Table of values

x	1	2	3	any value
y	0	0	0	fixed



Hence, $y = 0$ is the equation of x-axis.

Example 2. Draw the graph of the line $x - 2y = 3$. From the graph find co-ordinates of the points when

(*i*) $x = -5$, (*ii*) $y = 0$

Solution: The given equation is $x - 2y = 3$

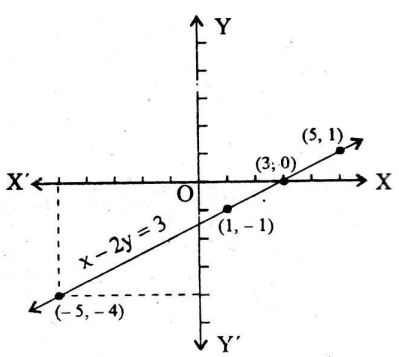
Table of value

x	3	5	1
y	0	1	–1

$\because \quad 2y = x - 3$

$\therefore \quad y = \dfrac{x-3}{2}$

Plotting the points (3, 0), (5, 1) and (1, –1) on the graph paper and joining these points.



From the graph,

(*i*) when $x = -5$, then $y = -4$

(*ii*) when $y = 0$, then $x = 3$

Example 3. Draw the graph of the equations

$5x + 3y = 4$.

Solution: The given equation is $5x + 3y = 4$

$\Rightarrow \quad y = \dfrac{4-5x}{3}$

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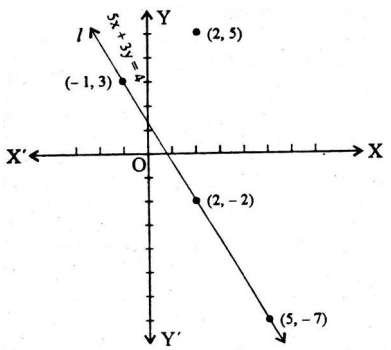
Table of values

x	–1	2	5
y	3	–2	–7

Plot the points (–1, 3), (2, –2) and (5, –7) on the graph paper and join these points.



Hence, the line l is called the graph of the equation,

$5x + 3y = 4$

Example 4. Draw the graph of the equation

$2x - 3y = -11$.

Solution: The given equation is

$2x - 3y = -11$

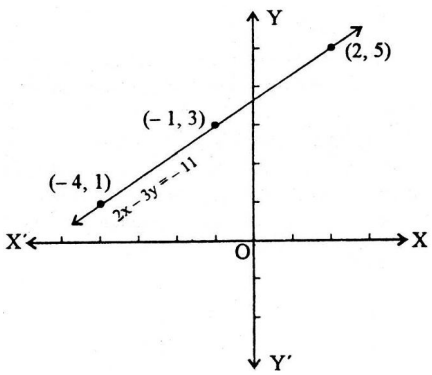
$\Rightarrow \quad 3y = 2x + 11$

$\Rightarrow \quad y = \dfrac{2x+11}{3}$

Table of values

x	–1	2	–4
y	3	5	1

plot the points (–1, 3), (2, 5) and (–4, 1) on the graph paper and join these points



Hence, this line l is called the graph of the equation

$2x - 3y = -11$.

EXERCISE

1. The system of linear equations $2x + 3y = 7$ and $4x + 6y = 10$ has:
A. no solution
B. unique solution
C. infinite solution
D. no conclusion can be drawn

2. The value of k for which the system of equations $x + 2y + 7 = 0$ and $2x + ky + 14 = 0$ will have infinitely many solutions is:
A. 2 B. 4
C. 6 D. 8

3. For what value of α, the system of equations $\alpha x + 3y = \alpha - 3$ and $12x + \alpha y = \alpha$ will have a unique solution?
A. $\alpha \neq \pm 6$ B. $\alpha \neq \pm 3$
C. $\alpha \neq \mp 6$ D. None of these

4. For what value of k, the system of equations will represent the coincident lines $x+5y-7=0$ and $4x+20y+k=0$?
A. 28 B. –28
C. –26 D. None of these

5. A lady has 50 paise and ₹ 1 coins in her purse. If in all, she has 40 coins totally ₹ 25.50 how many of each type of coins does she have?
A. 26, 11 B. 11, 29
C. 29, 11 D. None of these

6. A father is three times as old as his son. After twelve years his age will be twice as the age of his son. Find their present ages in years.
A. 12, 26 B. 24, 36
C. 36, 12 D. None of these

7. Ten years ago, father was twelve times as old as his son. Ten years after, he will be twice as old as his son will be. Find their present ages in years.
A. 12, 36 B. 12, 24
C. 12, 34 D. None of these

8. The present age of a father is 3 years more than three times the age of son. Three years hence father's age will be 10 years more than twice the age of son. Determine their present ages in years.
A. 10, 33 B. 33, 10
C. 10, 30 D. None of these

9. In a triangle ABC, $\angle C = 3\angle B = 2(\angle A + \angle B)$. Find three angles in degrees.
A. 20°, 50°, 120° B. 30°, 40°, 120°
C. 20°, 40°, 120° D. None of these

10. The fraction becomes 2 when 1 is added to both the numerator and the denominator, and it becomes 3 when 1 is subtracted from both the numerator and denominator. The given fraction is :
A. 7/3 B. 4/7
C. 3/7 D. 7/4

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ANSWERS

1	2	3	4	5	6	7	8	9	10
A	B	A	B	C	C	C	A	C	A

EXPLANATORY ANSWERS

1. $\frac{2}{4} = \frac{3}{6} \neq \frac{7}{10} \Rightarrow \frac{1}{2} = \frac{1}{2} \neq \frac{7}{10}$

$\frac{a_1}{a_2} = \frac{b_1}{b_2} \neq \frac{c_1}{c_2}$ $\therefore$ There is no solution.

2. Since, it has many solutions.

$\therefore \quad \frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{c_1}{c_2}$

$\frac{1}{2} = \frac{2}{K} = \frac{7}{14}$

$\frac{1}{2} = \frac{2}{K} \Rightarrow K = 4.$

3. Since, the given equations have unique solution.

$\therefore \quad \frac{a_1}{a_2} \neq \frac{b_1}{b_2}$

$\frac{\alpha}{12} \neq \frac{3}{\alpha}$

$\Rightarrow \quad \alpha^2 \neq 36 \Rightarrow \alpha \neq \pm 6$

4. Since, the given set of equations represent coincident lines.

then, $\frac{1}{4} = \frac{5}{20} = \frac{-7}{K} \Rightarrow K = -28$

5. Let, x be the number of 50 paise coins and y be the number of ₹ 1 coins.

According to the question,

$x + y = 40$ ...(*i*)

and $\frac{x}{2} + y = 25.50$

$\Rightarrow \quad x + 2y = 51$ ...(*ii*)

Subtracting equation (*i*) from (*ii*) and solving we get, $x = 29$, $y = 11$

6. Let, age of son = x years.

$\therefore$ age of father = $3x$ years.

According to the question,

$2(x + 12) = 3x + 12 \Rightarrow x = 12$

$\therefore$ Son's age = 12 years; Father's age = 36 years.

7. Let ten years ago, the age of son and father were x and $12x$ years.

Then, $2(x + 20) = 12x + 20$

$\Rightarrow \quad 10x = 20 \Rightarrow x = 2$

Their present ages are

$x + 10 = 2 + 10 = 12$ years

$12x + 10 = 24 + 10 = 34$ years.

9. $\therefore \angle C = 3\angle B = 2(\angle A + \angle B)$

$\angle A + \angle B = \frac{\angle C}{2}$

We have, $\angle A + \angle B + \angle C = 180°$

(Sum of angles of a triangle is 180°)

$\frac{\angle C}{2} + \angle C = 180°$

$3\angle C = 2 \times 180°$

$\angle C = \frac{2 \times 180°}{3} = 120°$

$3\angle B = \angle C$

$\angle B = \frac{\angle C}{3} = \frac{120°}{3} = 40°$

$\therefore \quad \angle A = 180° - (120° + 40°) = 180° - 160° = 20°.$

10. Let the fraction be $\frac{x}{y} \Rightarrow \frac{x+1}{y+1} = 2$

$\Rightarrow \quad x + 1 = 2y + 2$

$\Rightarrow \quad x - 2y = 1$ ...(*i*)

Again $\frac{x-1}{y-1} = 3$

$\Rightarrow \quad x - 1 = 3y - 3$

$\Rightarrow \quad x - 3y = -2$ ...(*ii*)

from (*i*) and (*ii*)

$x - 2y = 1$

$x - 3y = -2$

$- \quad + \quad +$

$y = 3$

Putting the value of y in (*i*) then we get, $x = 7$

$\therefore \quad$ fraction $= \frac{x}{y} = \frac{7}{3}$

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Average

The average of any number of quantities of the same kind can be found by dividing their sum by their number.

Thus,

$$\text{Average} = \frac{\text{Sum of quantities}}{\text{No. of quantities}}$$

Sum of quantities = Their average × Their number

$$\text{Number of quantities} = \frac{\text{Sum of quantities}}{\text{Their average}}$$

When a body coveres the same distance at two different speeds p km/hr and q km/hr, then its average speed for the whole journey is $\frac{2pq}{p+q}$ km/hr.

EXERCISE

1. The average of the fractions $1\frac{1}{2}$, $2\frac{1}{3}$, $3\frac{1}{3}$ and $4\frac{5}{6}$ is:

A. 2 B. $2\frac{1}{2}$

C. 3 D. 4

2. The average of first nine multiples of 3 is

A. 12.0 B. 12.5

C. 15.0 D. 18.5

3. The average of 13 numbers is 68, the average of first 7 numbers is 63 and the average of last 7 numbers is 70. What is the 7th number?

A. 43 B. 45

C. 47 D. 49

4. One-third of a certain journey was covered at the rate of 25 km per hour, one-fourth at the rate of 30 km per hour and the rest at the 50 km per hour. What is the average speed per hour for whole journey?

A. $33\frac{1}{3}$ kmph B. $44\frac{1}{4}$ kmph

C. $22\frac{1}{2}$ kmph D. 33 kmph

5. Nine men went to a hotel. Eight of them spent ₹ 3 for each over their meals and the ninth spent ₹ 2 more than the average expenditure of all the nine. What is the total money spent by them?

A. ₹ 29.25 B. ₹ 29.50

C. ₹ 29 D. ₹ 30

6. An establishment is permitted an average monthly contingency expenditure of ₹ 500 per month during the financial year. When a trial check was made at the end of the first nine months of the year it was found that the average monthly contingency expenditure worked out to be ₹ 511. What average monthly expenditure for the next three months should be aimed at in order to attain the permissible average of ₹ 500 per month for the whole year?

A. ₹ 567 B. ₹ 467

C. 367 D. ₹ 667

7. Average age of 8 persons increased by 2 years, when two men whose ages are 20 and 24 years are replaced by two women. What is the average age of women?

A. 30 years B. 31 years

C. 28 years D. 33 years

8. A man had seven children. When their average age was 12 years, the child who was 6 years of age died. What was the average of the surviving children 5 years after the death of the child?

A. 15 years B. 16 years

C. 17 years D. 18 years

9. The weight of a body, calculated as the average of seven different experiments is 53.735 grams. The average of the first three is 54.005 grams, the fourth was greater than the fifth by 0.004 gram, while the average of the sixth and seventh was 0.010 gram less

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than the average of the first three. What is the weight of the body as obtained by the fourth experiment?
A. 53.068 gm B. 53.078 gm
C. 53.086 gm D. 53.072 gm

10. A batsman has a certain average of runs for 16 innings. In the 17th innings, he makes a score of 85 runs thereby increasing his average by 3. What is the average after the 17th inning?
A. 33 runs B. 34 runs
C. 37 runs D. 36 runs

11. The average of 50 numbers is 38. If two numbers namely 45 and 55 are discarded, the average of the remaining numbers is
A. 36.5 B. 37
C. 37.5 D. 37.52

12. The average of 6 observations is 12. A new seventh observation is included and the new average is decreased by 1. The seventh observation is
A. 1 B. 3
C. 5 D. 6

13. A man whose bowling average is 12.4 takes 5 wickets for 26 runs and thereby decreases his average by 0.4. The number of wickets, taken by him, before his last match, is
A. 85 B. 78
C. 72 D. 64

14. The average of marks obtained by 120 candidates was 35. If the average of marks of passed candidates was 39 and that of failed candidates was 15, the number of candidates who passed the examination is
A. 100 B. 110
C. 120 D. 150

15. The average of three numbers is 42. The first is twice the second and the second is twice the third. The difference between the largest and the smallest number is
A. 18 B. 36
C. 54 D. 72

ANSWERS

1	2	3	4	5	6	7	8	9	10
C	C	C	A	A	B	A	D	D	C
11	**12**	**13**	**14**	**15**					
C	C	A	A	C					

EXPLANATORY ANSWERS

1. Average $= \frac{1}{4}\left(\frac{3}{2}+\frac{7}{3}+\frac{10}{3}+\frac{29}{6}\right)$

$= \left(\frac{9+14+20+29}{24}\right) = \frac{72}{24} = 3$

2. Average $= \frac{3(1+2+3+4+5+6+7+8+9)}{9} = \frac{135}{9}$

$= 15$

3. Average of 13 numbers = 68

$\therefore$ Total of 13 numbers = 13 × 68 = 884

Average of last 7 numbers = 70

$\therefore$ Total of last 7 numbers = 7 × 70 = 490

$\therefore$ Average of first 6 numbers

= 884 − 490 = 394

$\therefore$ Average of first 7 numbers = 63

$\therefore$ Total of first 7 numbers = 63 × 7 = 441

$\therefore$ 7th number = 441 − 394 = 47

4. Let the total distance covered during journey = 60 km

$\frac{1}{3}$ of the distance covered during journey

$= 60 \times \frac{1}{3} = 20$ km

$\frac{1}{4}$ of the distance covered during journey

$= \frac{1}{4} \times 60 = 15$ km

$\therefore$ The distance covered during the rest of journey = 60 − (20 + 15) = 25 km

Time taken to cover 20 km at 25 km/h

$= \frac{20}{25}\text{hours} = \frac{4}{5}\text{hour}$

Time taken to cover 15 km at 30 km/h

$= \frac{15}{30}\text{hours} = \frac{1}{2}\text{hour}$

Time taken to cover 25 km at 50 km/h

$= \frac{25}{50}\text{hours} = \frac{1}{2}\text{hour}$

Total time taken $= \frac{4}{5}+\frac{1}{2}+\frac{1}{2} = \frac{9}{5}\text{hours}$

Hence average speed per hour

$= 60 \div \frac{9}{5} = \frac{60 \times 5}{9}$

$= \frac{100}{3}\text{km/h} = 33\frac{1}{3}\text{km/h}$

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5. Let the average expenditure of all the nine
= ₹ x
Now amount spent by eight
= ₹ 3 × 8 = ₹ 24
and total spent by the ninth = ₹ x + 2

$$\Rightarrow \quad \frac{26+x}{9} = x$$

$\therefore$ Average amount spent by nine = $\frac{26+x}{9}$

Total amount spent by nine = 24 + x + 2 = 26 + x

$$\Rightarrow \quad 9x = 26 + x$$

or, $8x = 26$

$$\Rightarrow \quad x = \frac{26}{8} = ₹\ 3.25$$

Hence total money spent
= ₹ (3.25 × 9) = ₹ 29.25

6. Average monthly expenditure permitted = ₹ 500
Total expenditure permitted for 12 months
= ₹ 500 × 12 = ₹ 6000
Expenditure incurred during the first nine months
= ₹ 511 × 9 = ₹ 4,599
Expenditure for the last three month
= ₹ (6000 – 4599) = ₹ 1,401
$\therefore$ Average monthly expenditure for the three months

$$= ₹\ \frac{1401}{3} = ₹\ 467$$

7. Total increase in the age of 8 persons
= 2 × 8 = 16 years
Total age of two men being replaced
= 20 + 24 = 44 years
Total of the age of two women = 44 + 16 = 60 years
$\Rightarrow$ The average age of women

$$= \frac{60}{2} = 30 \text{ years.}$$

8. Average age of 7 children = 12 years
Total ages of 7 children = 12 × 7 = 84 years
Age of 1 child who died = 6 years
Total ages of remaining 6 children
= 84 – 6 = 78 years
$\therefore$ Average age of 6 children = $\frac{78}{6}$ = 13 years
$\therefore$ Average age of 6 children after 5 years
= 13 + 5 = 18 years

9. Total weight of 7 experiments
= 53.735 × 7 = 376.145 gm
Total weight of first three
= 54.005 × 3 = 162.015 gm
The average of the 6th and 7th was 0.010 gm less than that of the first three.
$\therefore$ Average of the 6th and 7th
= 54.005 – 0.010 = 53.995 gm
$\therefore$ Total of the 6th and 7th = 53.995 × 2 = 107.990 gm
Thus, total of 4th and 5th
= 376.145 – (162.015 + 107.990) = 106.140 gm
The fourth was greater than the fifth by 0.004 gm

$$\therefore \quad \text{The fifth} = (106.140 - 0.004) \times \frac{1}{2} = \frac{106.136}{2}$$

= 53.068 gm
Hence, the fourth = 53.068 + 0.004
= 53.072 gm

10. Average increase in the score of 17 innings
= 3 runs
Total increase in the score of 17 innings
= 3 × 17 = 51 runs
$\therefore$ His average of 16 innings
= 85 – 51 = 34 runs
Hence, average after the 17th innings
= 34 + 3 = 37 runs

11. Total of 50 numbers = 50 × 38 = 1900
Total of 48 numbers
= 1900 – (45 + 55) = 1800

$$\therefore \quad \text{Average} = \frac{1800}{48} = 37.5$$

12. Seventh observation
= (7 × 11 – 6 × 12) = 5

13. Suppose the number of wickets taken before the last match = x

$$\Rightarrow \quad \frac{12.4x + 26}{x+5} = 12$$

$$\Rightarrow \quad 12.4x + 26 = 12x + 60$$

$$\Rightarrow \quad x = 85$$

14. Let the number of candidates who passed = x

$$\Rightarrow \quad 39 \times x + 15 \times (120 - x) = 120 \times 35$$

$$\Rightarrow \quad 24x = 4200 - 1800$$

$$\therefore \quad x = \frac{2400}{24} = 100$$

15. Let the third number = x
Then, second number = $2x$ and first number = $4x$

$$\therefore \quad \frac{x + 2x + 4x}{3} = 42$$

$$\Rightarrow \quad \frac{7x}{3} = 42 \Rightarrow x = \frac{42 \times 3}{7}$$

$$\Rightarrow \quad x = 18$$

So, (largest) – (smallest) = $(4x - x) = 3x = 54$

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CHAPTER 6

Partnership Business

When two or more than two persons agree to invest money to run a business jointly, this association or deal is called *partnership* and those who invest money are called *pertners.* The total investment is called the *capital.*

Kind of partners : There are two kinds of partners.

1. **Working or active partner :** When a partner devotes his time for the business in addition to invest his money, he is called a working partner.

   With mutual agreement, the active partners get some fixed percentage of profit as *working allowance.*

2. **Sleeping or non-active partner :** A partner who simply invests money, but does not attend to the business is called a sleeping partner.

Kind of partnership :

(i) **Simple partnership :** If the capitals of several partners are invested for the same period, it is called a simple partnership.

(ii) **Compound or complex partnership :** If the capitals of the partners are invested for diffrent intervals of time, the partnership is called compound or complex.

EXERCISE

1. A and B started a business with the investment of ₹ 80000 and ₹ 60000 respectively. At the end of the year total profit in the business will be divided between them in the ratio of :

A. 2 : 3 B. 3 : 4
C. 2 : 1 D. 4 : 3

2. A and B started a business in partnership with the investment of ₹ 4000 and ₹ 6000 respectively. If at the end of the year total profit is ₹ 2250, what will each of them get?

A. ₹ 900, ₹ 1350
B. ₹ 800, ₹ 1450
C. ₹ 1000, ₹ 1250
D. ₹ 1200, ₹ 1050

3. Sonu, Monu and Mohit together start a business with the investment of ₹ 1800, ₹ 1500 and ₹ 1600 respectively. If at the end of the year, Monu gains a profit of ₹ 900 the total profit in the business is :

A. ₹ 2880 B. ₹ 2940
C. ₹ 3200 D. ₹ 3240

4. Omdutt started a business with a capital of ₹ 8000. After six months, Sanjay joined him with investment of some capital. If at the end of the year each of them gets equal amount as profit, how much did Sanjay invest in the business?

A. ₹ 18000 B. ₹ 17500
C. ₹ 16000 D. ₹ 16500

5. A, B and C buy a farm for ₹ 100000. A contributes ₹ 40000 in it. They sell it, and from the profit B gets ₹ 2750 and C gets ₹ 1750. What would be the profit of A?

A. ₹ 2780 B. ₹ 3000
C. ₹ 3280 D. ₹ 2785

6. A and B jointly invest ₹ 2100 and ₹ 3100 respectively in a firm. A is an active partner and hence he gets 25% of the profit separately. If their business yields them total ₹ 1040 as profit, what will be the gain of each of them?

A. ₹ 415, ₹ 625 B. ₹ 575, ₹ 465
C. ₹ 515, ₹ 525 D. ₹ 560, ₹ 480

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7. Two partners invested ₹ 12500 and ₹ 8500 respectively in a business and decided that 60% of the profit incurred from the business will be equally divided between them while remaining profit will be assumed as interest on their capitals. If one of the partners gets ₹ 300 more profit than the other, what is the total profit in the business?
A. ₹ 3937.50 B. ₹ 4940.50
C. ₹ 3936.50 D. ₹ 4156

8. Neeraj and Birju are partners in a business. They divide between them the profit incurred in the business in such a proportion that $\frac{2}{5}$th portion of the profit gained by Neeraj is equal to $\frac{1}{3}$rd portion of the profit gained by Birju. If total profit in the business is ₹ 1210, find the profit earned by Birju.
A. ₹ 780 B. ₹ 660
C. ₹ 680 D. ₹ 590

9. A, B and C together took under lease a pasture ground for ₹ 888. If in this pasture ground A put his 20 sheep out to graze for 2½ months, B put his 30 sheep out to graze for 4 months and C put his 36 sheep out to graze for 3½ months, find the lease amount paid by each of them.
A. ₹ 205, ₹ 315, ₹ 378 B. ₹ 150, ₹ 360, ₹ 378
C. ₹ 170, ₹ 360, ₹ 358 D. ₹ 228, ₹ 360, ₹ 300

10. A, B and C started a business with the investment of ₹ 5000, ₹ 6000 and ₹ 4000 respectively. A is an active partner and therefore he gets 30% of the profit separately. Rest of the profit is divided in the ratio of their capitals. If at the end of year, A's profit is ₹ 200 more than the sum of the profits made by B and C, find the profit made by each of them.
A. ₹ 1620, ₹ 1242, ₹ 1178
B. ₹ 1720, ₹ 1252, ₹ 1228
C. ₹ 1510, ₹ 1187, ₹ 1133
D. ₹ 1600, ₹ 840, ₹ 560

11. Premchand, Nanak and Prabhat together rented a house for 2 years and settled to pay ₹ 1368 as rent. They lived together in this house for 5 months. Then Prabhat left the house and went away. 8 months after Nanak also went away and left the house for Premchand to live alone. How much did Premchand pay as rent of this house?
A. ₹ 1025 B. ₹ 950
C. ₹ 880 D. ₹ 780

12. A started a business with an investment of ₹ 4000. B joined him after 4 months and C joined him after 5 months. At the end of year they get profit in the ratio of 3 : 4 : 7. Find the ratio of capitals invested in the business by B and C.
A. 1 : 2 B. 2 : 1
C. 3 : 2 D. 1 : 3

13. Amit, Sumeet and Suresh started a business with capitals in the ratio of 2 : 3 : 4. Amit took back half of his investment after 3 months and Sumeet took back one-third portion of his investment after 4 months. If at the end of year, Suresh gets a profit of ₹ 3200, what is the total profit in the business?
A. ₹ $6076\frac{2}{3}$ B. ₹ $6066\frac{2}{3}$
C. ₹ 8000 D. ₹ $8333\frac{1}{3}$

14. A, B and C started a business in partnership. A invested ₹ 4000 for 8 months and ₹ 6000 for 4 months. B invested ₹ 3000 for 6 months and ₹ 5000 for next 6 months of the year while C invested ₹ 3000 for whole of the year. If at the end of year, total profit is ₹ 7000, what will be the shares of A, B and C in the profit?
A. ₹ 2800, ₹ 2400, ₹ 1800
B. ₹ 2500, ₹ 2600, ₹ 1900
C. ₹ 2600, ₹ 2500, ₹ 1900
D. ₹ 2000, ₹ 2700, ₹ 2300

15. A, B and C started a business in partnership with respective investment of ₹ 20000, ₹ 18000 and ₹ 12000. A and B are active partners and therefore they get an additional profit of 12% and 8% respectively for supervision and other related work they do for improvement of the trade. Rest of the profit is divided among them in the proportion of their capitals. If profit made by A is ₹ 648 more than B, find the profit earned by each of them.
A. ₹ 3960, ₹ 3312, ₹ 1728
B. ₹ 4960, ₹ 3312, ₹ 1728
C. ₹ 3690, ₹ 3132, ₹ 1820
D. ₹ 5960, ₹ 3600, ₹ 1750

16. Three labourers work for 5 hours, 6 hours and 7 hours respectively in a field and get wages in the proportion of time of working in the field. Three days after they increase their working hours by 1 hour. 4 days after they increase their working hours, work in the field gets finished. If their total wages is ₹ 276, find the share of wages earned by each of them.
A. ₹ 78, ₹ 92, ₹ 106 B. ₹ 88, ₹ 87, ₹ 101
C. ₹ 80, ₹ 90, ₹ 106 D. ₹ 81, ₹ 95, ₹ 100

17. A, B and C together took a pasture ground on rent at ₹ 16 per month with a view to graze their sheep in this ground. A, B and C owned 70, 50 and 40 sheep respectively. After 4 months A sold $\frac{2}{7}$th portion of his sheep to B and 3 month after that C sold $\frac{2}{5}$th portion of his sheep to A. How much will each of them pay as rent after the end of a year?
A. ₹ 70, ₹ 70, ₹ 52 B. ₹ 76, ₹ 76, ₹ 40
C. ₹ 80, ₹ 76, ₹ 36 D. ₹ 40, ₹ 76.30, ₹ 76

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18. Samir and Saurabh started a joint firm. Samir's investment was thrice the investment of Saurabh and the period of his investment was two times the period of investment of Saurabh. If Saurabh got ₹ 4000 as profit, then their total profit is:
A. ₹ 16000 B. ₹ 20000
C. ₹ 24000 D. ₹ 28000

19. A, B and C together start a business. The amounts invested by A and B are in the ratio of 4 : 3 whereas the ratio of investments of B and C is 2 : 3. If the total profit earned is ₹ 46000, what is C's share in the profit?
A. ₹ 14000 B. ₹ 15000
C. ₹ 16000 D. ₹ 18000

20. Rani and Nisha started a business initially with ₹ 5100 and ₹ 6600 respectively. If the total profit is ₹ 2730, what is the Rani's share in the profit?
A. ₹ 1190 B. ₹ 1200
C. ₹ 1530 D. ₹ 1540

ANSWERS

1	2	3	4	5	6	7	8	9	10
D	A	B	C	B	B	A	B	B	D
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
B	A	B	A	A	A	B	D	D	A

EXPLANATORY ANSWERS

1. Ratio between their profits = 80000 : 60000 = 4 : 3.

2. Ratio of capitals of A and B = 4000 : 6000 = 2 : 3

A's share in the profit = $\frac{2}{5}\times 2250$ = ₹ 900

B's share in the profit = $\frac{3}{5}\times 2250$ = ₹ 1350

3. Ratio of their capitals
= 1800 : 1500 : 1600 = 18 : 15 : 16
Sum of proportionals = 18 +15 + 16 = 49
Monu's profit = ₹ 900
∴ Total profit in the business = $\frac{900}{15}\times 49$ = ₹ 2940

4. Investment by Omdutt for 1 month
= ₹ 8000 × 12 = ₹ 96000
Let Sanjay invested ₹ x for 6 months
∴ Capital of Sanjay for 1 month = ₹ $x \times 6$ = ₹ $6x$
Now, $6x = 96000$
∴ x = ₹ 16000

5. Here, ratio of capitals of A and (B + C)
= 40000 : 60000 = 2 : 3
Profit of (B + C) = 2750 + 1750 = ₹ 4500
Hence, A's profit = $\frac{4500}{3}\times 2$ = ₹ 3000

6. Separate profit for A = $\frac{1040\times 25}{100}$ = ₹ 260
Remaining profit = ₹ (1040 – 260) = ₹ 780
Ratio of capitals of A and B = 2100 : 3100 = 21 : 31
A's profit = $\frac{21}{52}\times 780$ = ₹ 315
B's profit = $\frac{31}{52}\times 780$ = ₹ 465
Total profit of A = ₹ (315 + 260) = ₹ 575
Therefore A and B will make profit of ₹ 575 and ₹ 465 respectively.

7. Ratio of their capitals = 12500 : 8500 = 25 : 17
Hence, sum of their ratios = 25 + 17 = 42 and difference of ratios = 25 – 17 = 8
Now total profit taken as interest
= $\frac{300}{8}\times 42$ = ₹ 1575
Hence, total profit in the business
= $\frac{100}{40}\times 1575$ = ₹ 3937.50

8. Let shares of Neeraj and Birju in profit are ₹ x and ₹ y respectively; then,
$\frac{2}{5}x = \frac{1}{3}y$ ∴ $x : y = 5 : 6$
Hence, share of Birju = $\frac{6}{11}\times 1210$ = ₹ 660

9. Ratio of their shares = (20 × 5/2) : (30 × 4) : (36 × 7/2) = 25 : 60 : 63
Sum of proportionals = 25 + 60 + 63 = 148
Total lease amount = ₹ 888
∴ Amount paid by A = $\frac{25}{148}\times 888$ = ₹ 150
Amount paid by B = $\frac{60}{148}\times 888$ = ₹ 360
Amount paid by C = $\frac{63}{148}\times 888$ = ₹ 378

10. Ratio of capitals of A, B and C = 5000 : 6000 : 4000 = 5 : 6 : 4
Let total profit in the business = ₹ x; then
$\frac{30x}{100}+\frac{5}{15}\times\frac{70x}{100}-\frac{(6+4)}{15}\times\frac{70x}{100}=200$
$\Rightarrow \frac{8x}{15}-\frac{7x}{15}=200$ ∴ x = ₹ 3000
Hence, A's profit = $\frac{8\times 3000}{15}$ = ₹ 1600;

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B's profit = $\frac{6}{15}\times\frac{7\times3000}{10}$ = ₹ 840;

C's profit = $\frac{4}{15}\times\frac{7\times3000}{10}$ = ₹ 560

11. Rent for 1 month = $\frac{1368}{24}$ = ₹ 57

Total rent paid by Premchand

= $5\times\frac{57}{3}+8\times\frac{57}{2}+11\times57$

= 95 + 228 + 627 = ₹ 950.

12. Let, B and C invest ₹ x and ₹ y respectively

∴ Ratio of their capitals = 48000 : $8x$: $7y$

But given ratio of the profits = 3 : 4 : 7

$$8x : 7y = 4 : 7 \Rightarrow \frac{x}{y}=\frac{1}{2}$$

Hence, $x : y = 1 : 2$

13. Ratio of capitals of Amit, Sumeet and Suresh

= (2 × 3 + 1 × 9) : (3 × 4 + 2 × 8) : (4 × 12)

= 15 : 28 : 48

Sum of the ratios = 15 + 28 + 48 = 91

∴ Total profit in the business

= $\frac{91}{48}\times3200 = ₹\ 6066\frac{2}{3}$

14. Ratio of their capitals

= (4000 × 8 + 6000 × 4) : (3000 × 6 + 5000 × 6) : (3000 × 12)

= 56000 : 48000 : 36000 = 14 : 12 : 9

Sum of proportionals = 14 + 12 + 9 = 35

Share of A in the profit = $\frac{14}{35}\times7000$ = ₹ 2800

Share of B in the profit = $\frac{12}{35}\times7000$ = ₹ 2400

Share of C in the profit = $\frac{9}{35}\times7000$ = ₹ 1800

15. Ratio of their capitals

= 20000 : 18000 : 12000 = 10 : 9 : 6

Let total profit in the business = ₹ x; then

$$\left(\frac{12x}{100}+\frac{10}{25}\times\frac{80x}{100}\right)-\left(\frac{8x}{100}+\frac{9}{25}\times\frac{80x}{100}\right) = 648$$

$$\Rightarrow \frac{11x}{25}-\frac{46x}{125}=648 \Rightarrow \frac{9x}{125}=648$$

$$\therefore \quad x = \frac{648\times125}{9} = ₹\ 9000$$

Hence, share of A = $\frac{11x}{25} = \frac{11\times9000}{25}$

= ₹ 3960;

Share of B = $\frac{46x}{125}=\frac{46\times9000}{125}$ = ₹ 3312

Share of C = $\frac{6}{25}\times\frac{80x}{100}=\frac{6}{25}\times\frac{4}{5}\times9000$ = ₹ 1728

16. Ratio of their working hours

= (5 × 3 + 6 × 4) : (6 × 3 + 7 × 4) : (7 × 3 + 8 × 4)

= 39 : 46 : 53

Sum of proportionals = 39 + 46 + 53 = 138

∴ Wages for the 1st labourer = $\frac{39}{138}\times276$ = ₹ 78

Wages for the 2nd labourer = $\frac{46}{138}\times276$ = ₹ 92

Wages for the 3rd labourer = $\frac{53}{138}\times276$ = ₹ 106

17. Number of sheep of A for 1 month

= $[70\times4+(70-\frac{2}{7}\times70)\times3+(70-\frac{2}{7}\times70+\frac{2}{5}\times40)\times5]$

= 280 + 150 + 330 = 760

Number of sheep of B for 1 month

= $[50\times4+(50+\frac{2}{7}\times70)\times8]$ = 200 + 560 = 760

Number of sheep of C for 1 month

= $[40\times7+(40-\frac{2}{5}\times40)\times5]$ = 280 + 120 = 400

Hence, ratio of their sheep

= 760 : 760 : 400 = 19 : 19 : 10

Sum of proportionals = 19 + 19 +10 = 48

1 year's rent of the pasture ground = 16 × 12 = ₹ 192

∴ Rent to be paid by A = $\frac{19}{48}\times192$ = ₹ 76

Rent to be paid by B = $\frac{19}{48}\times192$ = ₹ 76

Rent to be paid by C = $\frac{10}{48}\times192$ = ₹ 40

18. Ratio of Capitals of Samir and Saurabh

= (3 × 2) : (1 × 1) = 6 : 1

Saurabh's profit = ₹ 4000

Hence, total profit in the business

= 7 × ₹ 4000 = ₹ 28000

19. A : B = 4 : 3 and B : C = 2 : 3,

Therefore, A : B : C = 8 : 6 : 9

Hence, C's profit = $\frac{9}{23}\times46000$ = ₹ 18000

20. Ratio of their Capitals = 5100 : 6600 = 17 : 22

Hence, Rani's profit = $\frac{17}{39}\times2730$ = ₹ 1190

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CHAPTER 7

Mixture and Alligation

Alligation deals with calculation of values or properties of a mixture. Alligation is the rule that enables us—

(1) to find the proportion in which the two or more ingredients at the given prices must be mixed to yield a mixture at the given price. This is termed as "Alligation Alternate".

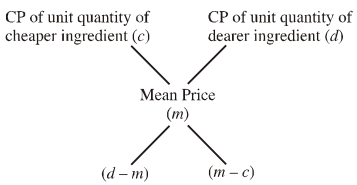
(2) to calculate the average or mean value of a mixture when the prices of two or more ingredients which are to be mixed together and proportion in which they are to be mixed are given. This is termed as "Alligation Medial".

1. Rule of Alligation:

$$\frac{\text{Amount of Cheaper ingredient}}{\text{Amount of Dearer ingredient}} = \frac{\text{Cost price of Dearer} - \text{Mean Price}}{\text{Mean Price} - \text{Cost Price of Cheaper}}$$

Here cost price of unit quantity of the mixture is called the *Mean Price.*

The above rule may be represented schematically as under:



(Cheaper quantity) : (Dearer quantity)
$= (d - m) : (m - c)$

This relationship is very helpful in solving problems on mixture involving percentage values, rates, prices, speeds etc.

2. m gm of sugar solution has x % sugar in it. To increase the sugar content in the solution to y %, quantity of sugar need to be added = $\frac{m(y-x)}{100-y}$

3. A vessel contains x litres of liquid A. y litres are withdrawn and replaced by liquid B. Next y litres of the mixture is withdrawn and again replaced by liquid B. This operation is repeated n times.

$$\frac{\text{Quantity of liquid A left after } n\text{th operation}}{\text{Whole quantity of liquid A initially present}} = \left(\frac{x-y}{x}\right)^n \text{ or } \left(1-\frac{y}{x}\right)^n$$

EXERCISE

1. In what proportion must tea at ₹ 62 per kg be mixed with tea at ₹ 72 per kg in order to obtain the mixture worth ₹ 65 per kg?
A. 4 : 6 B. 7 : 3
C. 2 : 3 D. 4 : 7

2. Find the quantity of rice @ ₹ 10 per kg. which should be mixed with 25 kgs of rice @ ₹ 8 per kg, so that on selling the mixture @ 15 per kg there is 80% profit.
A. 6 kgs B. 7 kgs
C. 3 kgs D. 5 kgs

3. A shopkeeper buys 26 kgs of milk @ ₹ 16 per kg. He also buys from another source an inferior quality of milk @ ₹ 10 per kg. How much quantity of the latter should he buy to mix it with the former so that he can sell the mixture @ ₹ 14 per kg without making any loss?
A. 13 kgs B. 12 kgs
C. 14 kgs D. 16 kgs

4. Two vessels A and B contain milk and water in the ratio 7 : 5 and 17 : 7 respectively. In what ratio mixtures from two vessels should be mixed to get a new mixture containing milk and water in the ratio 5 : 3?
A. 1 : 2 B. 2 : 1
C. 2 : 3 D. 3 : 2

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5. Two vessels A and B contain mixture of milk and water in the ratio 4 : 1 and 9 : 11 respectively. They are mixed in the ratio of 3 : 2. Find the ratio of milk : water in the resulting mixture.
A. 34 : 16 B. 33 : 17
C. 16 : 34 D. 17 : 33

6. A person has two solutions of sugar with 30% and 50% concentration respectively. In what proportion should he mix two solutions to get 45% concentration in the resulting mixture?
A. 1 : 3 B. 3 : 1
C. 2 : 3 D. 3 : 2

7. 6 litres of milk and water mixture has 75% milk in it. How much milk should be added to the mixture to make it 90% pure?
A. 8 litres B. 9 litres
C. 10 litres D. 12 litres

8. In what ratio must water be added to spirit to gain 25% by selling it at cost price?
A. 1 : 4 B. 4 : 1
C. 3 : 4 D. 4 : 3

9. A shopkeeper has 50 kgs of rice. He sells a part of it at 20% profit and the rest at 40% profit. If he gains 25% on the whole, find the quantity of each part.
A. 12.5 kgs and 37.5 kgs B. 37.5 kgs and 12.5 kgs
C. 23.5 kgs and 21.5 kgs D. 21.5 kgs and 23.5 kgs

10. A shopkeeper has 100 kgs of tea. He sells a part of it at 20% profit and the rest at 5% loss. If his overall profit is 10%, find the quantity for each part.
A. 20 kgs B. 25 kgs
C. 30 kgs D. 40 kgs

11. A merchant has 160 kgs of wheat. He sells a part of it at 10% profit and the rest of 6% loss. If he incurs 4% loss on the whole, find the quantity for each part.
A. 120 kgs B. 140 kgs
C. 150 kgs D. 160 kgs

12. A man bought a certain quantity of sugar for ₹ 8000. He sells one-fourth of it at 20% loss. At what per cent profit should he sell the remainder stock so as to make an overall profit of 20%?
A. 20% B. 30%
C. 35% D. 40%

13. A person has ₹ 5000. He invests a part of it at 3% per annum and the remainder at 8% per annum simple interest. His total income in 3 years is ₹ 750. Find the sum invested at different rates of interest.
A. ₹ 2000 and ₹ 3000 B. ₹ 2500 and ₹ 2500
C. ₹ 3000 and ₹ 2000 D. ₹ 2750 and ₹ 2250

14. A person covers a dista2nce of 100 kms in 10 hours, partly by walking at 7 km/hr and rest by running at 12 km/hr. Find the distance covered in each part.
A. 48 kms B. 72 kms
C. 108 kms D. 124 kms

15. The average monthly salary of employees, consisting of officers and workers, of an organisation is ₹ 3000. The average salary of an officer is ₹ 10,000 while that of a worker is ₹ 2000 per month. If there are total 400 employees in the organisation, find the number of officers and workers separately.
A. 300, 100 B. 50, 350
C. 250, 150 D. 310, 90

16. The average daily wages of staff, consisting of supervisors and labourers, of a company is ₹ 50. The average wages of supervisors is ₹ 150 while that of labourers is ₹ 40 per day. If the number of supervisors is 15, find the number of labourers in the company.
A. 150 B. 175
C. 180 D. 200

17. ₹ 675 was divided among 75 boys and girls. Each boy gets ₹ 20 whereas a girl gets ₹ 5. Find the number of boys and girls.
A. 20, 55 B. 15, 60
C. 25, 50 D. 30, 45

18. A sum of ₹ 70 is divided among 10 children. Each boy gets ₹ 10 whereas a girl gets ₹ 5. If the number of boys is 4, find the number of girls.
A. 6 B. 7
C. 8 D. 9

19. From a cask of wine containing 25 litres, 5 litres are withdrawn and the cask is refilled with water. The process is repeated a second and then a third time. Find the quantity of wine left in the cask and also the ratio of wine to water in the resulting mixture.
A. 61 : 64 B. 16 : 46
C. 46 : 16 D. 64 : 61

20. A vessel contains 80 litres of milk. 16 litres of milk was taken out of the vessel and replaced by water. Then 16 litres of mixture was withdrawn and again replaced by water. The operation was repeated for third time. How much milk is now left in the vessel?
A. 96.40 litres B. 50.36 litres
C. 40.96 litres D. 32.76 litres

ANSWERS

1	2	3	4	5	6	7	8	9	10
B	D	A	B	B	A	B	A	B	D
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
B	B	C	B	B	A	A	A	D	C

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EXPLANATORY ANSWERS

1. CP of 1 kg. Cheaper tea ₹ 62 — CP of 1 kg. Dearer tea ₹ 72

Mean Price per kg ₹ 65

$d - m = 7$ $\quad$ $m - c = 3$

Using Alligation rule,

$$\frac{\text{Quantity of cheaper tea}}{\text{Quantity of dearer tea}} = \frac{d-m}{m-c} = \frac{7}{3}$$

Therefore, they must be mixed in the ratio of 7 : 3.

3. 16 $\quad$ 10

14

4 $\quad$ 2

or 2 : 1 $\quad \dfrac{\text{Quantity of milk @ ₹ 10 per kg}}{\text{Quantity of milk @ ₹ 16 per kg}} = \dfrac{1}{2}$

So, quantity of milk @ ₹ 10 per kg. $= \dfrac{26}{2} = 13$ kgs.

5. Fraction is $\quad$ *Milk* $\quad$ *Water*

A : $\quad \dfrac{4}{5} \quad \dfrac{1}{5}$

B : $\quad \dfrac{9}{20} \quad \dfrac{11}{20}$

(3A + 2B) = A and B : $\left(\dfrac{12}{5}+\dfrac{9}{10}\right) \quad \left(\dfrac{3}{5}+\dfrac{11}{10}\right)$

$\dfrac{33}{10} \quad \dfrac{17}{10}$

So, Ratio of milk : water in the resulting mixture = 33 : 17.

6. 30% $\quad$ 50%

45%

5 $\quad$ 15

He should mix 30% and 50% in the ratio 5 : 15 or 1 : 3.

$\dfrac{30\%\text{ Solution}}{50\%\text{ Solution}} = \dfrac{1}{3}$ or 1 : 3

7. The given solution has 75% milk.

Milk to be added has 100% milk.

75% $\quad$ 100%

90%

10 $\quad$ 15

Milk should be added to the given mixture in the ratio 15 : 10 or 3 : 2.

$\therefore$ Quantity of milk to be added $= \dfrac{3}{2} \times 6 = 9$ litres.

8. Let cost price of spirit be ₹ 1 per litre.

Water 0 $\quad$ Spirit ₹ 1

₹ $\dfrac{4}{5}$

$\dfrac{1}{5}$ $\quad$ ₹ $\dfrac{4}{5}$

Then SP of mixture = ₹ 1 per litre

Gain = 25%

So, CP of mixture $= 1 \times \dfrac{100}{125} =$ ₹ $\dfrac{4}{5}$

We assume that CP of water is zero.

Using alligation rule on cost price,

Water should be mixed to spirit in the ratio $\dfrac{1}{5} : \dfrac{4}{5}$ or 1 : 4.

9. 20% $\quad$ 40%

25%

15 $\quad$ 5

or 3 : 1

Quantity sold at 20% profit $= \dfrac{3}{3+1} \times 50 = 37.5$ kgs.

Quantity sold at 40% profit = (50 – 37.5) = 12.5 kgs.

10. +20 $\quad$ –5

+10

10 – (–5) = 15 $\quad$ 10

or 3 : 2

Quantity sold at 20% profit $= \dfrac{3}{3+2} \times 100 = 60$ kgs.

Quantity sold at 5% loss = (100 – 60) = 40 kgs.

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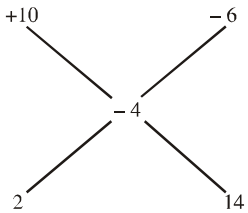
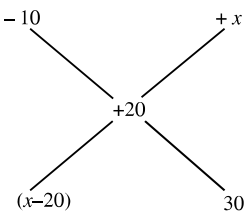
11. 

or 1 : 7

Quantity sold at 10% profit = $\frac{1}{1+7} \times 160 = 20$ kgs.

Quantity sold at 6% loss = 160 – 20 = 140 kgs.

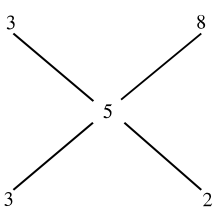
12. Let the remainder stock be sold at x% profit.



$$\frac{x-20}{30} = \frac{1/4}{3/4} \text{ or } x - 20 = 30 \times \frac{1}{3}$$

or $x = 20 + 10$, $x = 30\%$ profit.

13. Average rate of interest

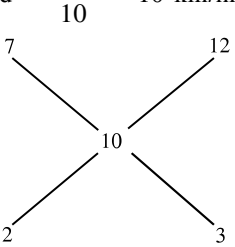


$$= \frac{100 \times 750}{5000 \times 3} = 5\% \text{ per annum}$$

Investment at 3% per annum = $\frac{3}{3+2} \times 5000 = ₹\ 3000$

Investment at 8% per annum = $\frac{2}{3+2} \times 5000 = ₹\ 2000$.

14. Average speed = $\frac{100}{10} = 10$ km/hr.

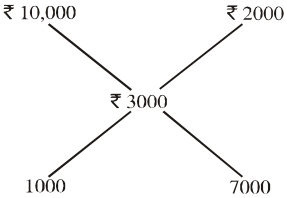


Ratio of time taken at 7 km/hr to 12 km/hr = 2 : 3

Time taken at 7 km/hr = $\frac{2}{2+3} \times 10 = 4$ hrs.

Distance covered at 7 km/hr = 7 × 4 = 28 km.

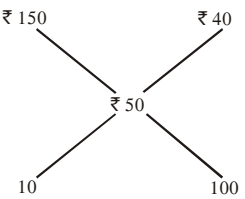
Distance covered at 12 km/hr = 100 – 28 = 72 km.

15. 

$$\frac{\text{Number of officers}}{\text{Number of workers}} = \frac{1000}{7000} = \frac{1}{7}$$

No. of officers = $\frac{1}{1+7} \times 400 = 50$

No. of workers = 400 – 50 = 350

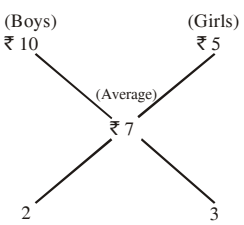
16. 

$$\frac{\text{Number of supervisors}}{\text{Number of labourers}} = \frac{10}{100} = \frac{1}{10}$$

Total number of labourers

= Total no. of supervisors × 10

= 15 × 10 = 150.

18. 

$$\frac{\text{Number of girls}}{\text{Number of boys}} = \frac{3}{2}$$

Number of girls = $\frac{3}{2} \times 4 = 6$

19. Here, quantity of wine left after third operation

$$= \left(1 - \frac{5}{25}\right)^3 \times 25$$

$$= \left(\frac{4}{5}\right)^3 \times 25 = \frac{64}{125} \times 25 = \frac{64}{5} = 12\frac{4}{5} \text{ litres.}$$

Final ratio of wine to water

$$= \frac{(64/125)}{(1-64/125)} = \frac{64/125}{61/125}$$

Wine : Water = $\frac{64}{61}$.

20. Amount of milk left

$$= 80\left(1 - \frac{16}{80}\right)^3 = 80\left(\frac{4}{5}\right)^3 = 80 \times \frac{64}{125}$$

= 40.96 litres.

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Time and Distance

Important Formulae:

1. Speed = Distance ÷ Time
2. Distance = Time × Speed
3. Time = Distance ÷ Speed
4. x km/hr = $\left(x \times \frac{5}{18}\right)$ m/sec
5. x metres/sec = $\left(x \times \frac{18}{5}\right)$ km/hr.
6. If the speed of a body is changed in the ratio $m : n$, then the ratio of the time taken changes in the ratio $n : m$.
7. When a man covers a certain distance with a speed of x km/h and another equal distance at the rate of y km/h, then for the whole journey, the average speed is given by

   Average speed = $\frac{2xy}{x+y}$ km/h.

EXERCISE

1. A car moving at 48 km/hr completes a journey in 10 hours. By how much the speed of this car should be increased so as to do this journey in 8 hours?
A. 8 km/hr. B. 12 km/hr
C. 10 km/hr D. 15 km/hr

2. Starting from a point at a speed of 4 km/hr a man reaches at a cerain place and returns back to the point from where he had started journey on bicycle at the speed of 16 km/hr. His average speed during the entire journey will be:
A. 6.4 km/h B. 8.4 km/h
C. 5.4 km/h D. 10 km/h

3. A motorist covers a certain distance at a average speed of 48 km/h in 45 minutes. What speed in km/h he must maintain to cover the same distance in 30 minutes?
A. 66 km/h B. 79 km/h
C. 80 km/h D. 72 km/h

4. Two points A and B are 150 km apart. A man completes his onward journey from A to B in 3 hours 20 minutes and return journey from B to A in 4 hours 10 minutes. His average speed during the entire journey will be less than his average speed during the journey from A to B by:
A. 5 km/h B. 7.5 km/h
C. 9 km/h D. 3 km/h

5. A policeman saw a thief at a distance of 200 m. The policeman and the thief started running at the same time. If the policeman runs at a speed of $4\frac{1}{6}$ m per second and the thief at a speed of $3\frac{1}{3}$m per second, after what time the policeman will catch the thief?
A. 12 min B. 10 min
C. 9 min D. 4 min

6. Kanchan walks from her home at 4 kms per hour and reaches her school 5 minutes late. If she walks at 5 kms per hour, she reaches the school 2½ minutes earlier. How far is the school from her home?
A. 3.5 kms B. 2.5 kms
C. 2.75 kms D. 3.2 kms

7. A monkey wants to climb up a glazed pole. He climbs 12 metres in 1 minute and then he slips back 3 metres in the next minute. If the pole is 63 metre high, how long does he take to climb at the top of the pole?
A. $11\frac{1}{4}$min B. $12\frac{1}{2}$min
C. $12\frac{3}{4}$min D. $14\frac{3}{4}$min

8. A and B start walking at the same time on a circular path with circumference 35 metre. If they walk in the same direction at 4 km/hr and 5 km/hr respectively, after what time will they meet together?

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A. 35 hours B. 27 hours
C. 24 hours D. 40 hours

9. While walking at $\frac{3}{5}$ of his usual speed Kamalkant reaches at his destination late by 30 minutes. His usual time consumed in reaching to his destination is:
A. 32 min B. 40 min
C. 45 min D. 42 min

10. The distance between two stations A and B is 300 km. A train leaves the station A with a speed of 40 km/hr. At the same time another train departs from the station B with a speed of 50 km/hr. How much time will these two trains take to cross each other?
A. 3 hrs 40 min B. 3 hrs 20 min
C. 2 hrs 20 min D. 3 hrs 45 min

11. Gulshan starts from a place P at 2 p.m. and walks to Q at 5 km per hour. Tarun starts from P at 3 p.m. and follows Gulshan on bicycle at 10 km per hour. By when Tarun will catch Gulshan?
A. At 5.30 p.m. B. At 4.00 p.m.
C. At 4.30 p.m. D. At 6.00 p.m.

12. Nilesh goes to school from his village at the speed of 4 km/hr and returns from school to village at the speed of 2 km/hr. If he takes 6 hours in all, then what is the distance between the village and the school?
A. 8 km B. 6 km
C. 5 km D. 4 km

13. A school bus covers a distance from a village to school at the speed of 12 km/hr and reaches the school 8 minute late. The next day the bus covers the same distance at the speed of 20 km/hr and reaches the school 10 minutes early. What is the distance between village and the school?
A. 6 km B. 9 km
C. 12 km D. 15 km

14. By increasing the speed of the bus by 10 km/hr the time of journey for 72 km is reduced by 36 minutes. What was the original speed of the bus?
A. 30 km/hr B. 35 km/hr
C. 40 km/hr D. 45 km/hr

15. A car completes a fixed journey in 8 hours. It covers half distance at the speed of 40 km/hr and rest at the 60 km/hr, the distance of the journey is:
A. 400 km B. 420 km
C. 384 km D. 350 km

16. A car covers four consecutive extensions of 3 km each at the speeds of 10 km/hr, 20 km/hr, 30 km/hr and 60 km/hr. Its average speed of journey is:
A. 30 km/hr B. 25 km/hr
C. 20 km/hr D. 10 km/hr

17. A girl rides her bicycle 10 km at an average speed of 12 km/hr and another 12 km at an average speed of 10 km/hr. Her average speed for the entire journey is approximately:
A. 12.2 km/hr B. 11.2 km/hr
C. 10.8 km/hr D. 10.4 km/hr

18. Raman drove from home to a neighbouring town at the speed of 50 km/hr and on his returning journey, he drove at the speed of 45 km/hr and also took an hour longer to reach home. What distance did he cover each way?
A. 900 km B. 500 km
C. 450 km D. 225 km

19. A man takes 6 hours 35 minutes in walking to a certain place and riding back. He would have taken 2 hours less by riding both ways. What would be the time he would take to walk both ways?
A. 10 hours B. 8 hours 35 minutes
C. 8 hours 25 minutes D. 8 hrs

20. A man covers a distance of 6 km at the rate of 4 km/hr and other 4 km at 3 km/hr this average speed is
A. $3\frac{5}{9}$ km/hr B. $3\frac{9}{17}$ km/hr
C. $5\frac{9}{17}$ km/hr D. $9\frac{3}{17}$ km/hr

ANSWERS

1	2	3	4	5	6	7	8	9	10
B	A	D	A	D	B	C	A	C	B
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
B	A	B	A	C	C	C	C	B	B

EXPLANATORY ANSWERS

1. Let he has to increase his speed by x km/hr for given condition; then,
$(48 + x) \times 8 = 48 \times 10$
$\Rightarrow \quad 48 + x = 60 \ \therefore \ x = 12$ km/hr

2. Average speed during the entire journey
$= \frac{2xy}{x+y} = \frac{2\times4\times16}{4+16} = \frac{8\times16}{20} = 6.4$ km/hr.

3. Let required speed be x km/hr; then
$x \times \frac{1}{2} = 48 \times \frac{3}{4} \ \therefore \ x = 48 \times \frac{3}{4} \times 2 = 72$ km/hr

4. During onward journey from A to B:
Average speed $= \frac{150}{10/3} = \frac{150\times3}{10} = 45$ km/hr.

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During entire jouney:

$$\text{Average speed} = \frac{300}{\frac{10}{3}+\frac{25}{6}} = \frac{300\times 6}{45} = 40 \text{ km/hr.}$$

Hence, difference of average speed
$= 45 - 40 = 5$ km/hr.

5. Suppose the policeman will catch the thief after t sec

then, $\left(\frac{25}{6}-\frac{10}{3}\right)t = 200 \Rightarrow \frac{5}{6}t = 200$

$\therefore\ t = \frac{200\times 6}{5} = 240$ sec $= 4$ min.

6. Suppose the distance between her house to the school $= x$ km

Difference of time $= \frac{5}{2} - (-5) = \frac{15}{2}$ min $= \frac{1}{8}$ hr.

$\frac{x}{4}-\frac{x}{5}=\frac{1}{8} \Rightarrow \frac{x}{20}=\frac{1}{8} \therefore x = \frac{20}{8} = 2.5$ km

7. The monkey climbs 12 metres in 1 minute and then he slips back 3 metres in the next minute

$\therefore$ The monkey climbs in the first 2 minutes $= 12 - 3 = 9$ metres

$\therefore$ In the first 12 minutes the monkey climbs $= 9 \times 6 = 54$ metres

Remaining height of the pole to be covered by the monkey $= 63 - 54 = 9$ metre

$\therefore$ The monkey will climb the height of 9 metres in the 13th minute

$\because$ The monkey climbs 12 metres in 1 minute

$\therefore$ The monkey will climb 9 metres in

$\frac{1}{12}\times 9 = \frac{3}{4}$ minute

$\therefore$ Time spent in climbing at the top of the pole

$= \left(12+\frac{3}{4}\right)$ minutes $= 12\frac{3}{4}$ minutes

8. The two persons walk in the same direction

$\therefore$ Their relative speed $= 5 - 4 = 1$ km/hr

Distance covered in 1 round on the circular path = 35 km

$\therefore$ They will meet after $\frac{35}{1} = 35$ hours.

9. Suppose usual speed of Kamalkant is v km/hr and his destination is at a distance of x kms; then usual time taken $= \frac{x}{v}$ hours.

$\frac{x}{3v/5}-\frac{x}{v}=\frac{1}{2} \Rightarrow \frac{2x}{3v}=\frac{1}{2} \therefore \frac{x}{v}=\frac{3}{4}$ hour $= 45$ min.

10. The two trains are moving in the opposite directions

$\therefore$ Relative speed $= 40 + 50 = 90$ km/hr.

$\therefore$ Time taken to cross each other

$= \frac{300}{90} = 3\frac{1}{3}$ hours or, 3 hours 20 minutes.

11. Let Tarun will catch Gulshan after t hours the starting of Tarun; then, $10t = 5(t + 1)$

$\Rightarrow 5t = 5 \therefore t = 1$ hr

Hence, required time = 3 p.m. + 1 hr. = 4 p.m.

12. Let x km be the distance between village and the school; then

$\frac{x}{4}+\frac{x}{2}=6 \Rightarrow \frac{3x}{4}=6 \therefore x = \frac{6\times 4}{3} = 8$ km

13. Let x km be the distance from village to school, then

$\frac{x}{12}-\frac{x}{20} = [8 - (-10)] \times \frac{1}{60}$

$\Rightarrow \frac{x}{30}=\frac{18}{60} \therefore x = \frac{18}{60}\times 30 = 9$ km

14. Let original speed of the bus be x km/hr; then

$$\frac{72}{x}-\frac{72}{x+10}=\frac{36}{60} \Rightarrow \frac{72(x+10-x)}{x^2+10x} = \frac{3}{5}$$

$\Rightarrow 1200 = x^2 + 10x$

$\Rightarrow x^2 + 10x - 1200 = 0$

$\Rightarrow (x + 40)(x - 30) = 0$

$\therefore\ x = 30$ or $x = -40$

Taking positive value only, so speed of the bus = 30 km/hr.

15. Let the distance of the journey be x km, then,

$$\frac{x}{2\times 40}+\frac{x}{2\times 60} = 8 \Rightarrow \frac{5x}{240}=8$$

$\therefore\ x = 8 \times 48 = 384$ km

16. Total distance of the journey $= 4 \times 3$ km $= 12$ km

Total time taken $= \frac{3}{10}+\frac{3}{20}+\frac{3}{30}+\frac{3}{60}=\frac{36}{60}=\frac{3}{5}$ hr.

Hence, average speed $= \frac{12}{3/5}=\frac{12\times 5}{3} = 20$ km/hr.

17. Average speed

$$= \frac{10+12}{\frac{10}{12}+\frac{12}{10}} = \frac{22}{61/30} = \frac{22\times 30}{61} = \frac{660}{61} = 10.8 \text{ km/hr}$$

18. Let his distance of journey of each way be x km; then

$\frac{x}{45}-\frac{x}{50}=1 \Rightarrow \frac{x}{450} = 1$

$\therefore\ x = 450$ km

19. Here, Walking to a certain place + riding back = 6 hrs 35 min. ...*(i)*

2 × riding the same distance = 4 hrs 35 min. ...*(ii)*

Multiplying equation *(i)* × 2 and subtracting *(ii)* we get

Time taken in walking both ways = 13 hrs 70 min – 4 hrs. 35 min = 8 hrs. 35 min.

20. His average speed $= \frac{6+4}{\frac{6}{4}+\frac{4}{3}} = \frac{10}{17/6} = \frac{60}{17} = 3\frac{9}{17}$ km/hr

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Time and Work

IMPORTANT FACTS:

1. If A can do a piece of work in n days, then work done by A in 1 day = $\frac{1}{n}$.
2. If work done by A in 1 day = $\frac{1}{n}$; then A can finish the whole work in n days.
3. If A is twice as good a workman as B then; Ratio of work done by A and B = 2 : 1
   Ratio of times taken by A and B to finish a work = 1 : 2.

EXERCISE

1. 12 boys can do a piece of work in 16 days. In how many days can 6 boys do the same work?
A. 16 days B. 32 days
C. 23 days D. 24 days

2. A can do a piece of work in 8 days while B can do the same work in 16 days. If they start working together, how long would they take to complete half portion of this work?
A. $2\frac{2}{3}$ days B. $3\frac{5}{7}$ days
C. $4\frac{1}{2}$ days D. $3\frac{1}{2}$ days

3. A can do a piece of work in 4 days. B is 50% more efficient than A. How long would B alone take to finish this work?
A. $3\frac{1}{3}$ days B. $5\frac{1}{4}$ days
C. $2\frac{2}{3}$ days D. $1\frac{2}{3}$ days

4. A and B working together complete a work in 35 days. If A takes 60 days to complete it, how long would B alone take to complete it?
A. 64 days B. 72 days
C. 81 days D. 84 days

5. A few children working together can do a piece of work in 18 days. If the number of children employed on the work is made double, how long would they take to complete half of the work?
A. $4\frac{1}{2}$ days B. $2\frac{1}{3}$ days
C. $8\frac{3}{4}$ days D. $6\frac{1}{2}$ days

6. 10 men or 18 boys can do a piece of work in 15 days. In how many days would 25 men and 15 boys complete the same work working together?
A. $5\frac{1}{2}$ days B. $4\frac{1}{2}$ days
C. $6\frac{2}{3}$ days D. $2\frac{1}{3}$ days

7. A can do a piece of work in 40 days. He starts working, but having some other engagements he drops out after 5 days. Thereafter B completes this work in 21 days. How many days would A and B take to complete this work working together?
A. 15 days B. 16 days
C. 17 days D. 11 days

8. Two persons A and B can complete a piece of work in 8 hours and 16 hours respectively. If they work at it alternately for an hour, A starting first, in how many hours will the work be finished?
A. $9\frac{1}{3}$ hours B. $10\frac{1}{2}$ hours
C. $11\frac{1}{2}$ hours D. $8\frac{1}{2}$ hours

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9. 15 men can complete a work in 210 days. They started the work but at the end of 10 days 15 additional men, with double efficiency, were inducted. How many days, in whole, did they take to finish the work?

A. $76\frac{2}{3}$ days B. $84\frac{3}{4}$ days

C. $72\frac{1}{2}$ days D. 70 days

10. A and B working together can complete a piece of work in 12 days and B and C working together can complete the same work in 16 days. A worked at it for 5 days and B worked at it for 7 days. C finished the remaining work in 13 days. How many days would C alone take to complete it?

A. 10 days B. 24 days

C. 32 days D. 40 days

11. A cistern is filled by a tap in $3\frac{1}{2}$ hours. Due to a leak in the bottom of the cistern, it takes half an hour longer to fill the cistern. If the cistern is full, how long will it take the leak to empty it?

A. 28 hours B. 29 hours

C. $31\frac{1}{3}$ hours D. 38 hours

12. A is twice as good a workman as B and thrice as good a workman as C. If C alone can do a piece of work in 24 days, how long would the three persons take to finish the work working together?

A. $3\frac{3}{11}$ days B. $4\frac{4}{7}$ days

C. $4\frac{4}{11}$ days D. $3\frac{4}{11}$ days

13. Two pipes can fill a tank in 8 hours and 12 hours respectively whereas an escape pipe can empty it in 6 hours. If the three pipes are opened at 1 p.m., 2 p.m. and 3 p.m. respectively, at what time will the tank be filled?

A. 7.00 a.m. B. 8.00 a.m.

C. 5.00 a.m. D. 7.30 a.m.

14. Working 7 hours daily 24 men can complete a piece of work in 27 days. In how many days would 14 men complete the same piece of work working 9 hours daily?

A. 32 days B. 31 days

C. 36 days D. 39 days

15. A, B and C undertake to do a piece of work for ₹ 529. If A and B working together do $\frac{19}{23}$ work and B and C working together do $\frac{8}{23}$ work, how should the money be divided among them?

A. ₹ 345, ₹ 102, ₹ 82

B. ₹ 345, ₹ 92, ₹ 92

C. ₹ 330, ₹ 107, ₹ 92

D. ₹ 330, ₹ 92, ₹ 107

ANSWERS

1	2	3	4	5	6	7	8	9	10
B	A	C	D	A	B	A	B	A	B
11	**12**	**13**	**14**	**15**					
A	C	A	C	B					

EXPLANATORY ANSWERS

1. ∵ 12 boys can do a piece of work in 16 days.
∴ 1 boy will do the same piece of work in 16×12 days.
∴ 6 boys will do the same piece of work in $\frac{16 \times 12}{6}$ days = 32 days.

2. (A + B)'s 1 day's work = $\frac{1}{8}+\frac{1}{16}=\frac{3}{16}$

Hence, (A + B) will do the whole work in $\frac{16}{3}$ days

So, they will do the half portion of the work in $\frac{16}{3\times 2}$ days = $\frac{8}{3}=2\frac{2}{3}$ days.

3. A's 1 day's work = $\frac{1}{4}$;

Hence, B's 1 day's work = $\frac{150}{100}\times\frac{1}{4}=\frac{3}{8}$

So, B will do the whole work in $\frac{8}{3}=2\frac{2}{3}$ days.

4. (A + B)'s 1 day's work = $\frac{1}{35}$

and also, A's 1 day's work = $\frac{1}{60}$

Hence, B's 1 day's work

= $\frac{1}{35}-\frac{1}{60}=\frac{5}{420}=\frac{1}{84}$

So, B will do the whole work in 84 days.

5. Let number of children be x;
Now x children can do the work in 18 days.

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Hence, $2x$ children will do $\frac{1}{2}$ of the work in $\frac{18\times x}{2x\times 2}=\frac{9}{2}$ days = $4\frac{1}{2}$ days.

6. 10 men ≡ 18 boys; 25 men ≡ $\frac{18}{10}\times 25 = 45$ boys

Hence, 25 men + 15 boys = 45 + 15 = 60 boys

Now, 18 boys can do a piece of work in 15 days.

Hence, 60 boys will do a piece of work in $\frac{15\times 18}{60}=\frac{9}{2}$ days = $4\frac{1}{2}$ days.

7. A's 5 days' work = $5\times\frac{1}{40}=\frac{1}{8}$

Remaining work = $1-\frac{1}{8}=\frac{7}{8}$, which is done by B in 21 days.

Hence, B's 1 day's work = $\frac{7}{8\times 21}=\frac{1}{24}$

Now, (A + B)'s 1 day's work = $\frac{1}{40}+\frac{1}{24}=\frac{8}{120}=\frac{1}{15}$

Hence, (A + B) will complete the work in 15 days.

8. In 2 hours the part of work = $\frac{1}{8}+\frac{1}{16}=\frac{3}{16}$ will be completed.

Hence, in 5 pairs of hours the part of work

= 5 × $\frac{3}{16}=\frac{15}{16}$ will be completed

Remaining work = $1-\frac{15}{16}=\frac{1}{16}$ which will be done by A.

Time taken by A to complete the $\frac{1}{16}$ work

= $\frac{1/16}{1/8}=\frac{1}{2}$ hour.

Hence, required number of hours

= 10 + $\frac{1}{2}=10\frac{1}{2}$ hours.

9. 15 men's 10 days' work = $10\times\frac{1}{210}=\frac{1}{21}$

Remaining work = $1-\frac{1}{21}=\frac{20}{21}$

Now, (15 men + 15 men having double efficiency)'s 1 day's work = $\frac{1}{210}+\frac{2}{210}=\frac{3}{210}=\frac{1}{70}$

Hence, number of days

= $\frac{20/21}{1/70}=\frac{20}{21}\times 70=\frac{200}{3}=66\frac{2}{3}$ days

So, required number of total days

= 10 + $66\frac{2}{3}=76\frac{2}{3}$ days.

10. Here, A worked for 5 days, B for 7 days and C for 13 days ≡ (A + B) worked for 5 days, (B + C) for 2 days and C for 11 days.

Let C will complete the work in x days,

Now, (A + B)'s 5 days' work + (B + C)'s 2 days' work + C's 11 days' work

= $\frac{5}{12}+\frac{2}{16}+\frac{11}{x}=\frac{13}{24}+\frac{11}{x}$

Again, $\frac{13}{24}+\frac{11}{x}=1 \Rightarrow \frac{11}{x}=\frac{11}{24}$ $\therefore$ $x = 24$

Hence, C would alone complete the work in 24 days.

11. In 1 hour $\frac{2}{7}$ cistern is filled by the tap.

Hence, in $\frac{1}{2}$ hour $\frac{2}{14}=\frac{1}{7}$ cistern is filled by the tap.

So, $\frac{1}{7}$ cistern is emptied by the leakage in 4 hours.

So, 1 cistern will be emptied by the leakage in 28 hours.

13. Let tank will be filled up after t hours of starting of pipe A;

Then, $t\times\frac{1}{8}+(t-1)\times\frac{1}{12}-(t-2)\times\frac{1}{6}=1$

$\Rightarrow t\left(\frac{1}{8}+\frac{1}{12}-\frac{1}{6}\right)-\frac{1}{12}+\frac{1}{3}=1$

$\Rightarrow \quad t\times\frac{1}{24}=1-\frac{1}{4}$

$\therefore$ $t = \frac{3}{4}\times 24 = 18$ hours

Hence, required time = 1 p.m. + 18 hours = 7 a.m.

14. Working 7 hours a day 24 men can do the work is 27 days.

Hence, working 9 hours a day 14 men will do the work in $\frac{27\times 24\times 7}{9\times 14}$ = 36 days.

15. The part of work is done by B

= $\frac{19}{23}+\frac{8}{23}-1=\frac{4}{23}$

The part of work is done by A = $\frac{19}{23}-\frac{4}{23}=\frac{15}{23}$

The part of work is done by C = $\frac{8}{23}-\frac{4}{23}=\frac{4}{23}$

Hence, share of A = $\frac{15}{23}\times$ ₹ 529 = ₹ 345

share of B = $\frac{4}{23}\times$ ₹ 529 = ₹ 92

share of C = $\frac{4}{23}\times$ ₹ 529 = ₹ 92

So, Their shares are ₹ 345, ₹ 92 and ₹ 92.

● ● ●

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CHAPTER 10

Geometry

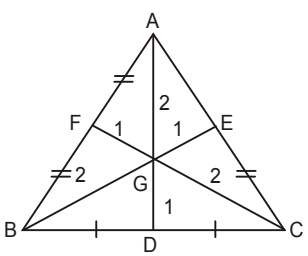
Triangle and Its Various Kinds of Centres

There are 4 very important ways of viewing the center of a triangle. We can look at its CENTROID, ORTHOCENTER, CIRCUMCENTER, and the INCENTER.

Centroid

The centroid is the first center and is obtained by locating the intersection of the three medians of the triangle. The median of a triangle is obtained by joining each vertex with the midpoint of the opposite side.

- It is the point of the intersection of the three median of the triangle. It is denoted by G.
- A centroid divides the area of the triangle in exactly three parts.



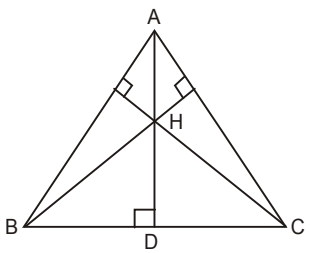
Medians:

- A line segment joining the midpoint of the side with the opposite vertex is called median.
- Median bisects the opposite side as well as divide the area of the triangle in two equal parts.

Orthocenter

The second center of a triangle is the orthocenter. It is obtained by finding the intersection of the 3 altitudes of the triangle. An altitude is found by joining each vertex with the point on the opposite side that creates a perpendicular line with the opposite side.

It is the point of intersection of all the three altitudes of the triangle.



$\angle BHC = 180 - \angle A$

$\angle AHB = 180 - \angle C$

$\angle AHC = 180 - \angle B$

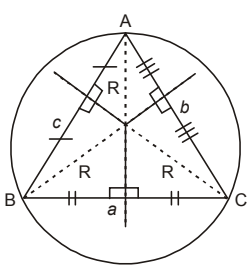
Position of orthocentre inside the triangle:

Acute angled triangle: lies inside the triangle.

Obtuse angle triangle: lies outside the triangle on the backside of the obtuse angle. Orthocentre and circumcentre lie opposite to each other in obtuse angle triangle.

Circumcenter

The third center is the circumcenter. The circumcenter is the intersection of the perpendicular bisectors of each side of the triangle. We can also think of this center as the point that is equidistant from each of the vertices. Since it is equidistant from each vertex, we can also construct a circle that passes through each vertex with the center being the circumcenter.



The distance between the circumcentre and the three vertices of a triangle is always equal.

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OA = OB = OC = R (circumradius) = $abc/4A$

$\angle BOC = 2\angle A$

$\angle AOC = 2\angle B$

$\angle AOB = 2\angle C$

Location of circumcentre in various types of triangle:

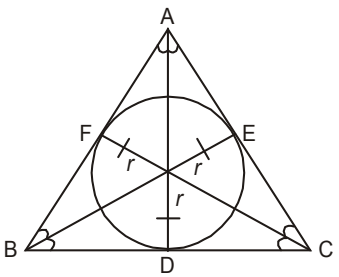
Acute angle triangle: Lies inside the triangle

Obtuse angle triangle: Lies outside the triangle

Right angle triangle: Lies at the midpoint of the hypotenuse.

Incenter

The last center is the incenter. The incenter is found by first constructing the angle bisectors of each of the three angles. The incenter is the intersection of these 3 segments.



The distance of the in-centre from the all the three sides is equal (ID = IE = IF = inradius "*r*")

In-radius (r) = Area of triangle/Semiperimetre = A/S

$\angle BIC = 90 + \angle A/2$

$\angle AIC = 90 + \angle B/2$

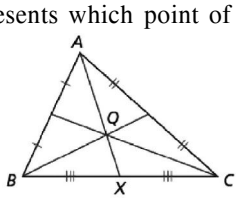
$\angle AIB = 90 + \angle C/2$

EXERCISE

1. In a triangle, a segment connecting the midpoints of two sides of the triangle is called a _____.

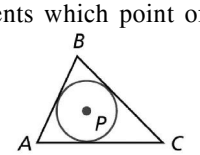
A. shortcut C. centroid
B. midsegment D. vertex

2. Point Q represents which point of concurrency?



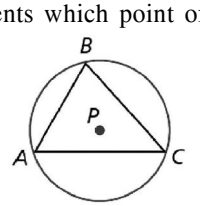
A. centroid C. orthocenter
B. incenter D. circumcenter

3. Point P represents which point of concurrency?



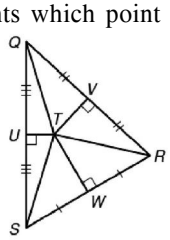
A. centroid C. orthocenter
B. incenter D. circumcenter

4. Point P represents which point of concurrency?



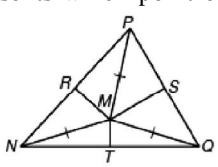
A. centroid B. incenter
C. orthocenter D. circumcenter

5. Point T represents which point of concurrency?



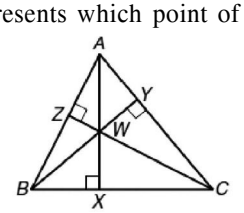
A. centroid B. incenter
C. orthocenter D. circumcenter

6. Point M represents which point of concurrency?



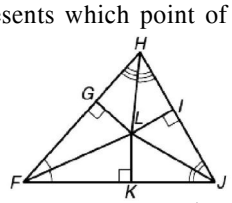
A. centroid B. incenter
C. orthocenter D. circumcenter

7. Point M represents which point of concurrency?



A. centroid B. incenter
C. orthocenter D. circumcenter

8. Point L represents which point of concurrency?



A. centroid B. incenter
C. orthocenter D. circumcenter

9. Which point of concurrency is the intersection of the medians of the triangle?

A. centroid B. incenter
C. orthocenter D. circumcenter

10. Which point of concurrency is the intersection of the altitudes of the triangle?

A. centroid B. incenter
C. orthocenter D. circumcenter

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11. Which point of concurrency is the intersection of the angle bisectors of the triangle?
A. centroid B. incenter
C. orthocenter D. circumcenter

12. Which point of concurrency is the intersection of the perpendicular bisectors of the triangle?
A. centroid B. incenter
C. orthocenter D. circumcenter

13. Which point of concurrency is equidistant from the three sides of a triangle?
A. centroid B. incenter
C. orthocenter D. circumcenter

14. Which point of concurrency is equidistant from the three verticies of a triangle?
A. centroid B. incenter
C. orthocenter D. circumcenter

15. Which point of concurrency is the center of gravity of a triangle?
A. centroid B. incenter
C. orthocenter D. circumcenter

ANSWERS

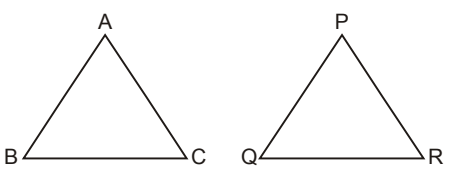
1	2	3	4	5	6	7	8	9	10
B	A	B	D	D	D	C	B	A	C
11	**12**	**13**	**14**	**15**					
B	D	B	D	A					

Congruence and Similarity of Triangles

Congruence of triangle: Two triangles having same shape and measurement but different positions are called congruent triangle.

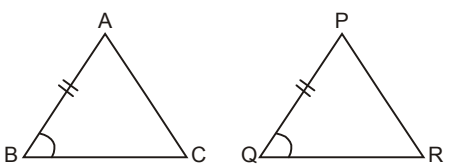
Congruence criterion

(*i*) **Side-Side-Side (SSS) Congruence criterion:** Two triangles are congruent if the three sides of one triangle are equal to the three sides of the other triangle.



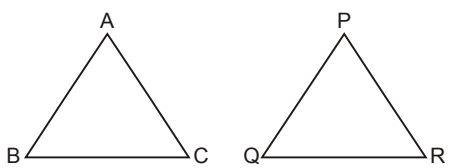
Here, AB = PQ, BC = QR and AC = PR
$\therefore$ $\Delta ABC \cong \Delta PQR$

(*ii*) **Side-Angle-Side (SAS) Congruence criterion:** Two triangles are congruent if two sides and the included angle of one are equal to the corresponding sides and the included angles of the other.



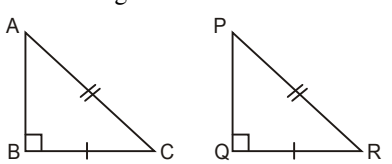
Here, AB = PQ, $\angle B = \angle Q$ and BC = QR
$\therefore$ $\Delta ABC \cong \Delta PQR$

(*iii*) **Angle-Side-Angle (ASA) Congruence criterion:** Two triangles are congruent if two angles and the included side of one triangle are equal to the corresponding two angles and the included side of the triangle.



$\because$ $\angle B = \angle Q$, $\angle C = \angle R$ and BC = QR
$\therefore$ $\Delta ABC \cong \Delta PQR$

(*iv*) **Right Angle-Hypotenuse-Side (RHS) congruence criterion:** Two right triangles are congruent. If the hypotenuse and one side of one triangle are respectively equal to the hypotenuse and one side of the other triangle.



$\because$ $\angle B = \angle Q = 90°$, AC = PR, BC = QR
$\therefore$ $\Delta ABC \cong \Delta PQR$.

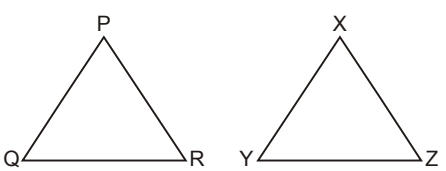
Similar Triangles: Two triangles having same shape but not necessarily of the same size, called similar triangle.

Basic properties of similar triangles:

(*i*) The corresponding angles of similar triangles are equal.

(*ii*) The corresponding sides of similar triangles are proportional.

The symbol for similar or is similar to is ~



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$\angle P = \angle X$, $\angle Q = \angle Y$ and $\angle R = \angle Z$

Then, $\frac{PQ}{QR} = \frac{XY}{YZ}$ or, $\frac{PR}{PQ} = \frac{XZ}{XY}$

Thus, $\Delta PQR \sim \Delta XYZ$

→ Congruent triangles are always similar but similar triangles may or may not be congruent.

→ Any two equilateral triangles are always similar triangles.

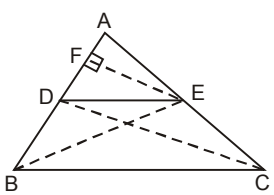
SOME IMPORTANT THEOREMS

Basic Proportionality Theorem: (Thalse Theorem)

Theorem 1: *In a triangle, a line drawn parallel to one side to intersect the other sides in distinct points divides the two sides in the same ratio.*

Given: A ΔABC in which DE is drawn parallel to side BC.

To prove. $\frac{AD}{DB} = \frac{AE}{EC}$.



Const.: Join BE and CD. Draw $EF \perp AB$.

Proof: ar.(ΔBDE) = ar.(ΔCDE) ...(1)

[$\because$ Δs on the same base DE and between the same parallels are equal in area]

$$\frac{\text{ar.}(\Delta ADE)}{\text{ar.}(\Delta BDE)} = \frac{\frac{1}{2}\times AD\times EF}{\frac{1}{2}\times BD\times EF}$$

[$\because$ Area of $\Delta = \frac{1}{2}$ base × height]

$$\Rightarrow \quad \frac{\text{ar.}(\Delta ADE)}{\text{ar.}(\Delta BDE)} = \frac{AD}{DB} \qquad ...(2)$$

Similarly, $\frac{\text{ar.}(\Delta ADE)}{\text{ar.}(\Delta CDE)} = \frac{AE}{EC}$ ...(3)

$$\therefore \quad \frac{\text{ar.}(\Delta ADE)}{\text{ar.}(\Delta BDE)} = \frac{AE}{EC}$$

[from (1) and (3)] ...(4)

$$\therefore \quad \frac{AD}{DB} = \frac{AE}{EC} \quad \text{[from (2) and (4)]}$$

Corollary 1: $\frac{AD}{DB} = \frac{AE}{EC}$

Adding 1 to both sides, we get

$$\frac{AD}{DB}+1 = \frac{AE}{EC}+1$$

$$\Rightarrow \quad \frac{AD+DB}{DB} = \frac{AE+EC}{EC}$$

Corollary 2: $\frac{AD}{DB} = \frac{AE}{EC}$

$$\Rightarrow \quad \frac{DB}{AD} = \frac{EC}{AE}$$

Adding 1 to both sides, we get

$$1+\frac{DB}{AD} = 1+\frac{EC}{AE}$$

$$\Rightarrow \quad \frac{AD+DB}{AD} = \frac{AE+EC}{AE}$$

$$\Rightarrow \quad \frac{AB}{AD} = \frac{AC}{AE}.$$

Converse of Basic Proportionality Theorem

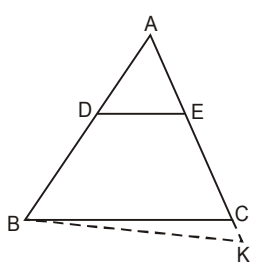
Theorem 2: *If a line divides any two sides of a triangle in the same ratio, prove that it is parallel to the third side.*

Given: A ΔABC, DE is st. line such that

$$\frac{AD}{DB} = \frac{AE}{EC}$$

To Prove. DE ∥ BC

Const.: If DE is not ∥ BC, draw BK ∥ DE meeting AC produce in.



Proof: In DABK, DE ∥ BK

$$\therefore \quad \frac{AD}{DB} = \frac{AE}{EK} \qquad ...(1)$$

[$\because$ A line drawn ∥ to one side of a Δ divides the other two sides in the same ratio]

But, $\frac{AD}{DB} = \frac{AE}{EC}$ (given) ...(2)

From (1) and (2), we get

$\frac{AE}{EK} = \frac{AE}{EC}$ or, EK = EC

which is possible only when C and K coincides.

Hence, DE ∥ BC.

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EXERCISE

1. Two similar triangles have
A. equal sides B. equal areas
C. equal angles D. None of these

2. Two congruent triangles have
A. proportional sides
B. equal sides
C. equal corresponding sides
D. equal corresponding angles

3. Which of the following is false for two congruent triangles?
A. Corresponding angles are equal.
B. Two sides and included angles are equal.
C. Corresponding sides are equal.
D. Two angles and one side are equal.

4. If the sides of a triangle are 8 cm, 12 cm and 15 cm then the angle is
A. Right angle B. Obtuse angle
C. Acute angle D. None of these

5. If two triangles are on the same base and between the parallel lines then they will be
A. equilaterals B. right angled
C. equal in area D. congruent

6. If the three heights of a traingle are equal then it is
A. right angled triangle B. obtuse angled triangle
C. equilateral triangle D. None of these

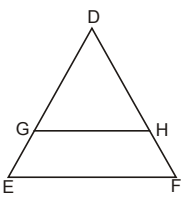
7. If two corresponding sides and the angle between them of a traingle are equal to another triangle. Then the angles are :
A. congruent but not similar
B. similar but not congruent
C. neither congruent nor similar
D. congruent and similar.

8. Ratio of areas of two similar triangles is equal to :
A. ratio of squares of the corresponding altitudes
B. ratio of squares of corresponding medians.
C. Either (A) or (B)
D. (A) and (B) both

9. If the areas of two similar triangles are equal then the triangles :
A. are congruent
B. have equal length of corresponding sides
C. (A) and (B)
D. None of these

10. Two isosceles triangles have equal vertical angles and their areas are in the ratio of 9 : 25 then the ratio between their corresponding heights is :
A. 5 : 3 B. 25 : 9
C. 3 : 5 D. 16 : 9

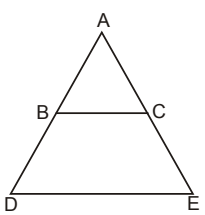
11. If in a Δ DEF, GH $\parallel$ EF and DG : EG = 2 : 3 then the value of $\frac{\text{ar}(\Delta\text{ DGH})}{\text{ar}(\Delta\text{ DEF})}$ is :



A. $\frac{2}{15}$ B. $\frac{4}{15}$
C. $\frac{4}{25}$ D. $\frac{2}{25}$

12. Sides of two similar triangles are in the ratio of 5 : 11 then ratio of their areas is :
A. 25 : 11 B. 25 : 121
C. 125 : 121 D. 121 : 25

13. If $\Delta ABC \sim \Delta ADE$ and ar (Δ ADE) = 9 ar (Δ ABC) then $\frac{BC}{DE}$ is equal to :



A. $\frac{1}{3}$ B. $\frac{1}{9}$
C. $\frac{3}{4}$ D. None of these

14. In a triangle a line is drawn from the mid-point of one side of and parallel to another side then
A. the line bisects the whole traingle
B. bisects the third side
C. bisects the opposite angle
D. None of these

15. If in a ΔABC, $\angle B = \angle C$ and BD = CE then which of the following is true
A. $DE = \frac{1}{2} BC$ B. DE $\parallel$ BC
C. (A) and (B) D. None of these

ANSWERS

1	2	3	4	5	6	7	8	9	10
C	C	D	C	C	C	C	D	C	C

11	12	13	14	15
C	B	A	B	B

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EXPLANATORY ANSWERS

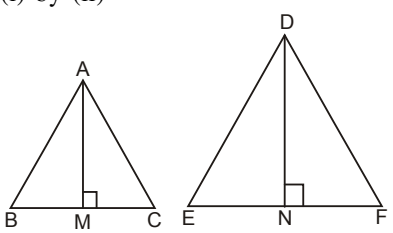
10. According to equestion

$\angle A = \angle D$ and $\frac{ar(\Delta ABC)}{ar(\Delta DEF)} = \frac{9}{25}$

Since, $AB = AC$ (given) ....(*i*)

$DE = DF$ (given) ....(*ii*)

Dividing (i) by (ii)



$\frac{AB}{DE} = \frac{AC}{DF}$ ...(*iii*)

Hence, $\Delta ABC \sim \Delta DEF$

[By SAS criterion of similar Δs]

In ΔAMC and ΔDNF

$\angle AMC = \angle DNF = 90°$

$\angle C = \angle F$ (because $\Delta ABC \sim \Delta DEF$)

$\therefore \angle AMC \sim DNF$

(By AA Criterion of similar Δs)

$\therefore \quad \frac{AC}{DF} = \frac{AM}{DN}$

and, $\frac{ar(\Delta ABC)}{ar(DEF)} = \frac{AC^2}{DF^2} = \frac{AM^2}{DN^2}$

$\therefore \quad \frac{AM^2}{DN^2} = \frac{9}{25}$

$\Rightarrow \quad \frac{AM}{DN} = \frac{3}{5}$

Hence required ratio = 3 : 5

11. $\frac{DG}{EG} = \frac{2}{3} \therefore \frac{DG}{DE} = \frac{2}{2+3} = \frac{2}{5}$

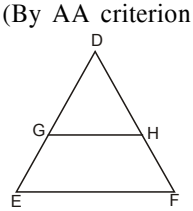
In ΔDGH and ΔDEF, $\angle D = \angle D$

$\angle DGH = \angle DEF$

(Since, GH ‖ EF and DE is the transversal among corresponding angles)

$\therefore \quad \Delta DGH \sim \Delta DEF$

(By AA criterion of similar triangles)



$\therefore \quad \frac{ar(\Delta DGH)}{ar(\Delta DEF)} = \frac{DG^2}{DE^2} = \frac{2^2}{5^2} = \frac{4}{25}$

12. Since, ratio of area of two similar traingles = ratio of square of corresponding sides

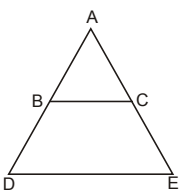
ratio of sides = 5 : 11

$\therefore$ ratio of their areas = $(5)^2 : (11)^2 = 25 : 121$.

13. From question,

$ar(\Delta ADE) = 9\ ar(\Delta ABC)$

or, $\frac{ar(\Delta ABC)}{ar(\Delta ADE)} = \frac{1}{9} = \frac{BC^2}{DE^2}$



Hence, $\frac{BC}{DE} = \sqrt{\frac{1}{9}} = \frac{1}{3}$

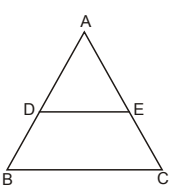
14. From question, In ΔABC, D is the mid-point of AB and DE is drawn parallel to BC and it meets at E on AC.

Since, $DE \parallel BC$ (By B.P. Theorem)

$\frac{AD}{DB} = \frac{AE}{EC}$ ...(*i*)

also, $AD = DB$ ($\because$ D is mid-point)

$\therefore \quad \frac{AD}{DB} = 1$



Now, $\frac{AE}{EC} = 1$ (From ...(*i*))

$\Rightarrow \quad AE = EC$

Hence, the line bisects the third line

15. According to questions, $\angle B = \angle C$ (given)

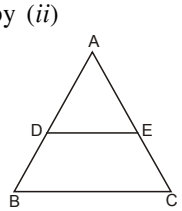
$\Rightarrow \quad AB = AC$ (*i*)

and, $BD = CE$ (*ii*)

Subtracting (*ii*) from (*i*), $AB - BD = AC - CE$

$\Rightarrow \quad AD = AE$ (*iii*)

Dividing (*iii*) by (*ii*)



$\frac{AD}{BD} = \frac{AE}{CE}$

$\therefore$ DE ‖ BC [By converse of BP Theorem]

Hence, option (B) is true.

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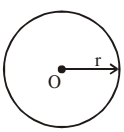
Circle and Its Chord

A circle is a set of those points in a plane that are at a given constant distance from a given fixed point in the plane. The fixed point is called the **centre of the circle** and the constant distance of every point on the circle from its centre of called the **radius of the circle**.

Things to Remember

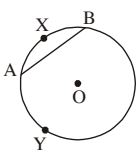
1. Locus of a point moving in a plane such that its distance from a fixed point in the same plane remains constant is called a circle.



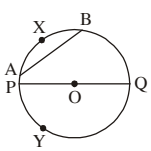
2. The fixed point O is called its centre and the constant distance *r* is called the radius.

3. The path traced by the moving point as described above is called the circumference of the circle.

4. The part of the plane containing the circle that consists the circle and its interior is called the circular region.



5. Line segment joining any two points on the circumference is called a chord of the circle. In the above figure AB is a chord of the circle.



6. The chord passing through the centre of the circle is called its diameter.

In the above figure PQ is a diameter of the circle.

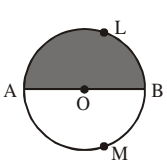
7. Diameter is the longest chord of the circle.

8. Any fraction of the circumference is called an arc of the circle.

9. The remaining part of the circumference is called the alternate segment of the circle with respect to the arc.

10. An arc of a circle smaller in length than the semicircle is called a minor arc. In the above figure arc AXB is a minor arc.

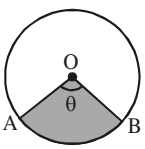
11. An arc of a circle more in length than the semicircle is called a major arc. In the above figure arc AYB is a major arc.



12. Diameter of a circle divides its circumference into two equal arcs. Each of them is called a semicircle.

13. The part of the plane containing the semicircle that consists the semi-circle, the enclosing diameter and its interior is called the semicircular region.

In the above figure region ALB and region BMA are semicircular regions.

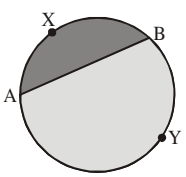


14. The angle formed by joining the end points of an arc to the centre of the circle is said to be the angle subtended by an arc at the centre of the circle. In the above figure, θ is the degree measure of arc AB.

15. The part of the plane containing the circle that consists of the arc enclosing radii and its interior is called the sector of the circle. In the above figure AOB is sector of the circle.

16. A chord of the circle other than a diameter divides the circular region into two unequal parts.

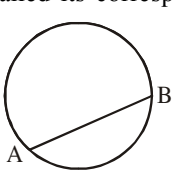
Each of these parts is called a segment. The larger part is called the major segment and the smaller is called the minor segment.



In the above figure segment AXB is a minor segment and segment BYA is the major segment.

17. Two circles in a plane are said to be concentric if they have same centre but different radii.

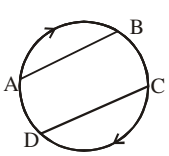
18. The chord formed by joining the end points of an arc of a circle is called its corresponding chord.



In the given figures chord AB is the corresponding chord of arc AB.

Important Theorems on Circles

1.



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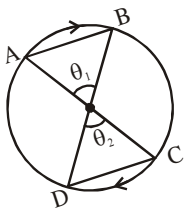
(*a*) If two arcs of a circle are equal then their corresponding chords are also equal.
AB = CD
$\Leftrightarrow$ arcAB = arcCD.

(*b*) If two chords of a circle are equal then their corresponding arcs are also equal.

2.

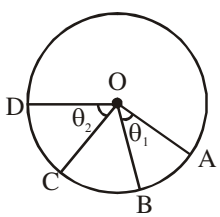


(*a*) If two chords of a circle are equal then they subtend equal angles at the centre of the circle.

(*b*) If two chords of a circle subtend equal angles at the centre of a circle then they are equal

$AB = CD \Leftrightarrow \theta_1 = \theta_2$

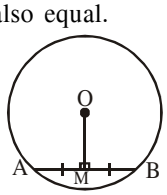
3.



(*a*) If two arcs of a circle have same degree measure then they are equal.
arc AB = arc CD
$\Leftrightarrow \theta_1 = \theta_2$

(*b*) If two arcs of a circle are equal then their degree measures are also equal.

4.

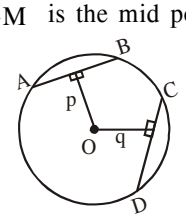


(*a*) Perpendicular to a chord from the centre of the circle bisects the chord.

(*b*) Line segment joining the centre of the circle to the mid point of the chord is perpendicular to the chord.

$OM \perp AB \Leftrightarrow$ M is the mid point of AB.

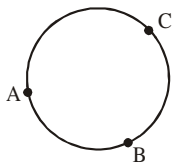
5.



(*a*) If two chords of a circle are equidistant from the centre of the circle, they are equal.

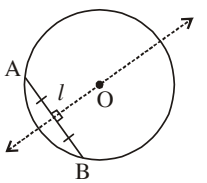
(*b*) If two chords of a circle are equal then they are equidistant from the centre of the circle
$AB = CD \Leftrightarrow p = q$

6.



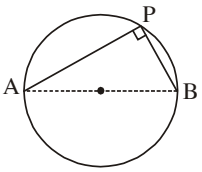
Through any three non collinear points, passes one and only one circle. A, B and C are three non-collinear points in a plane then one and only one circle passes through them.

7. Perpendicular bisector of a chord of a circle passes through the centre of the circle.



l is the $\perp$ bisector of AB $\Leftrightarrow$ *l* passes through O.

8.

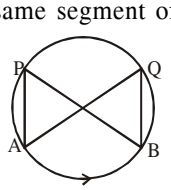


(*a*) **Theorem of Thales:** Angle in a semicircle is a right angle.

(*b*) If an arc subtends a right angle at any point in its alternate segment then it is a semi-circle.

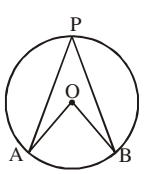
$\overset{\frown}{APB}$ is a semicircle $\Leftrightarrow \angle APB = 90°$

9. Angles in the same segment of a circle are equal



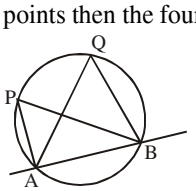
In the above figure $\angle APB = \angle AQB$

10.



Degree Measure Theorem : Degree measure of an arc is twice the angle subtended by it at any point on the alternate segment of the circle with respect to the arc. In the above figure $\angle AOB = 2\angle APB$

11. If a line segment joining two points subtends equal angles at two other points on same side of the line containing the two points then the four points are concyclic.



In the above figure $\angle APB = \angle AQB$, then A,B,Q and P are concylic.

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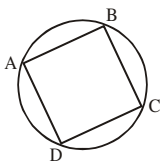
Definition

A quadrilateral is said to be cyclic if all of its four vertices lie on the circle, ABCD is a cyclic quadrilateral.



12. If in a quadrilateral the pair of opposite angles is supplementary then the quadrilateral is cyclic.

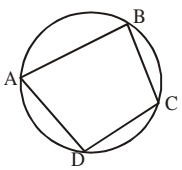
In the above figure

$\angle A + \angle C = 180°$

or $\angle B + \angle D = 180°$.

$\Rightarrow$ ABCD is cyclic quadrilateral.

13. Sum of each pair of opposite angles of a cyclic quadrilateral is 180°.



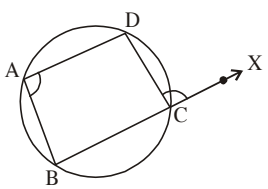
In the above figure

ABCD is cyclic quadrilateral

$\Rightarrow \angle A + \angle C = 180°$

and $\angle B + \angle D = 180°$.

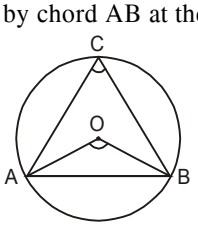
14. Exterior angle of a cyclic quadrilateral is equal to its opposite interior angle.



In the above figure, $\angle DCX = \angle A$

Angle subtended by a Chord

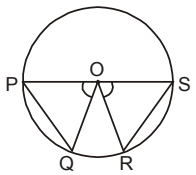
The angle subtended by the chord AB at a point C (not on the chord AB) on the circumference of the circle is $\angle ACB$. The angle subtended by chord AB at the centre O is $\angle AOB$.



Activity: Let us find out the relation between the size of the chord and the angle subtended by it at the centre.

We draw many chords and angles subtended by them at the centre. We observe that the longer is the chord the bigger will be the angle subtended by it at the centre. We draw two equal chords and measure the angles subtended by them at the centre. We find that the angles subtended by them at the centre are equal.

Theorem 1. Equal chords of a circle subtend equal angles at the centre.



Given. A circle such that

Chord PQ = Chord RS

To prove, $\angle POQ = \angle ROS$

Proof. In ΔPOQ and ΔROS,

PQ = RS

OP = OS = radius

OQ = OR = radius

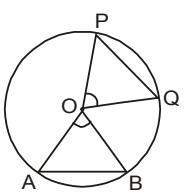
$\therefore$ $\Delta POQ \cong \Delta ROS$

(By SSS Theorem of congruence)

$\Rightarrow$ $\angle POQ = \angle ROS$ (C.P.C.T.)

$\Rightarrow$ Angles subtended by equal chords are equal.

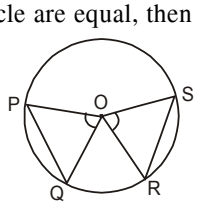
Activity, We draw a circle with centre O and draw an angle AOB, where A and B are the points on the circle. Draw another angle $\angle POQ$ at the centre equal to $\angle AOB$. Separate these two angles AOB and POQ. If we put segment AOB on the segment POQ of the circle, we find that they cover each other.



So, AB = PQ

Repeat this activity for other equal angles. We find the chords are equal in each case.

Theorem 2. If the angles subtended by the two chords at the centre of a circle are equal, then the chords are equal.



Given. Two chords PQ and RS of a circle in which,

$\angle POQ = \angle ROS$; PQ = RS

To prove.

Proof. In ΔPOQ and ΔROS

OP = OR = radius

$\angle POQ = \angle ROS$

OQ = OS = radius

$\therefore$ $\Delta POQ \cong \Delta ROS$

[By SAS Theorem of congruence]

$\Rightarrow$ PQ = RS (C.P.C.T.)

Hence, Chords are equal.

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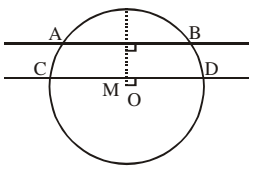
EXERCISE

1. AB and CD are two parallel chords of a circle such that AB = 5 cm and CD = 11 cm. If distance between them is 3 cm then radius of the circle is



A. $2\sqrt{146}$ cm B. $\sqrt{146}$ cm

C. $\frac{\sqrt{146}}{2}$ cm D. None of these

2. The maximum number of common tangents to any pair of circles in the same plane is :

A. 4 B. 5

C. 2 D. 3

3. Find the length of a chord which is at a distance of 3 cm from the centre of a circle of radius 5 cm.

A. 2 cm B. 6 cm

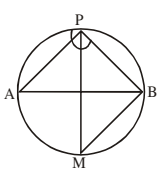
C. 8 cm D. 10 cm

4. If AB and AC are two chords of a circle of radius 5 cm such that AB = AC = $4\sqrt{5}$ cm then the length of the chord BC is :

A. 8 cm B. 8.4 cm

C. 9 cm D. None of these

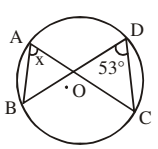
5. In the given figure AB is the diameter of the circle, PM bisects ∠APB then the measure of ∠ABM is :



A. 45° B. 30°

C. 15° D. 60°

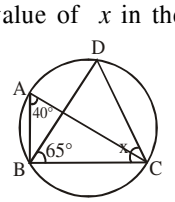
6. Determine the value of x in the figure given below.



A. 53° B. 106°

C. 26.5° D. 100°

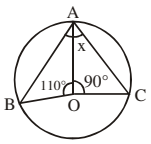
7. Determine the value of x in the figure given below.



A. 40° B. 75°

C. 65° D. 105°

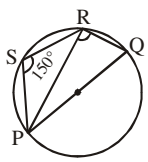
8. Determine the value of x in the figure given below.



A. 80° B. 100°

C. 90° D. 110°

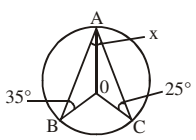
9. PQ is a diameter and PQRS is a cyclic quadrilateral. If ∠PSR = 150°, then measure of ∠RPQ is :



A. 90º B. 60º

C. 30º D. None of these

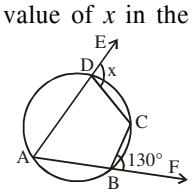
10. Determine the value of x in the figure given below.



A. 35° B. 25°

C. 30° D. 60°

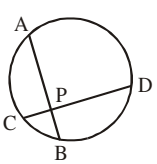
11. Determine the value of x in the figure given below.



A. 65° B. 60°

C. 50° D. 80°

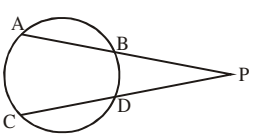
12. Chords AB and CD of a circle meet inside the circle at D. If PA = 4 cm, AB = 7 cm and PD = 6 cm then length of CD is :



A. 8 cm B. 6 cm

C. 2 cm D. None of these

13. Chords AB and CD of a circle when product meet out side the circle at P, If AB = 4 cm; BP = 3 cm and CP = 14 cm then the length of CD is



A. 3 cm B. 4.5 cm

C. 6 cm D. None of these

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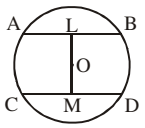
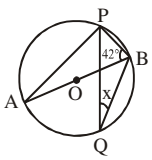
14. AB and CD are two parallel chords of circle such that AB = 10 cm and CD = 24 cm. If LM = 17 cm then the diameter of the circle is



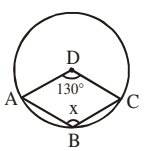
A. 13 cm B. 26 cm
C. 14 cm D. None of these

15. In the given figure determine the value of x.



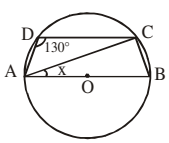
A. 48° B. 42°
C. 60° D. 38°

16. In the given figure determine the value of x.



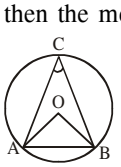
A. 90° B. 115°
C. 130° D. 65°

17. Find x



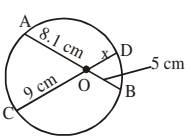
A. 40° B. 50°
C. 30° D. 60°

18. If O is the centre of the circle and ΔAOB is an equilateral triangle, then the measure of ΔACB is



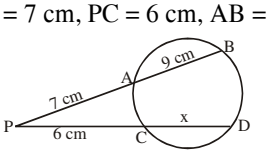
A. 60° B. 30°
C. 90° D. 75°

19. Find x if AO = 8.1 cm, BO = 5 cm, OC = 9 cm and OD = x cm.



A. 4.1 cm B. 4.1 cm
C. 4.2 cm D. 4.5 cm

20. Find x if PA = 7 cm, PC = 6 cm, AB = 9 cm and CD = x



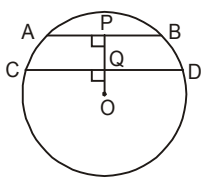
A. 12.0 cm B. 12.6 cm
C. 12.66 cm D. 12.67 cm

21. Two chords AB, CD of lengths 5 cm, 11 cm respectively of a circle are parallel. If the distance between AB and CD is 3 cm, find the radius of the circle.

A. $\frac{\sqrt{146}}{2}$ B. $\frac{\sqrt{150}}{2}$

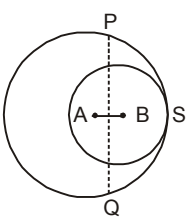
C. $\frac{150}{3}$ D. $\frac{100}{2}$

22. O is the centre of the circle of radius 5 cm, OP $\perp$ AB, OQ $\perp$ CD, AB $\parallel$ CD, AB = 6 cm and CD = 8 cm. Determine PQ.



A. 5 cm B. 10 cm
C. 1 cm D. 2 cm

23. Two circle with centres A and B and of radii 5 cm and 3 cm, respectively touch each other internally. If the perpendicular bisector of segment AB meets the bigger circle in P and Q. Find the length of PQ.



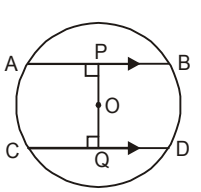
A. $4\sqrt{6}$ cm B. $3\sqrt{2}$ cm

C. $5\sqrt{4}$ cm D. $3\sqrt{5}$ cm

24. AB and CD are two parallel chords of a circle, which are an opposite sides of the centre, such that AB = 10 cm, CD = 24 cm and the distance between AB and CD is 17 cm. Find the radius of the circle.

A. 15 cm B. 13 cm
C. 14 cm D. 20 cm

25. O is the centre of the circle with radius 5 cm. OP $\perp$ AB, OQ $\perp$ CD, AB $\parallel$ CD, AB = 8 cm and CD = 6 cm. Determine PQ.



A. 3 cm B. 4 cm
C. 5 cm D. 7 cm

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ANSWERS

1	2	3	4	5	6	7	8	9	10
C	A	C	A	A	A	B	A	B	D
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
C	A	D	B	A	B	A	B	D	C
21	**22**	**23**	**24**	**25**					
A	C	A	B	D					

EXPLANATORY ANSWERS

1. Let OM = x

Then $x^2+\left(\frac{11}{2}\right)^2=r^2$ and $(x+3)^2+\left(\frac{5}{2}\right)^2=r^2$

Then, $x^2+6x+9+\frac{25}{4}=x^2+\frac{121}{4}$

$\Rightarrow 6x = 15 \Rightarrow x = 2.5$ cm

Thus, $r^2=(2.5)^2+\frac{121}{4}=\frac{146}{4} \Rightarrow r=\frac{\sqrt{146}}{2}$ cm

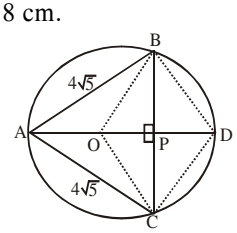
3. Length of chord = $2.\sqrt{5^2-3^2}=8$ cm.

4. Let OP = x and BP = y

Then $x^2+y^2=25$ and $(5+x)^2+y^2=80$

Solving these two, we get, y = BP = 4 cm

Thus, BC = 8 cm.



5. $\angle ABM=\angle APM=\frac{1}{2}\angle APB=\frac{1}{2}\times 90^\circ=45^\circ$

6. As angle in the same segment are equal.

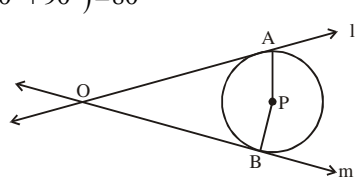
$x = 53°$

7. $x+65^\circ+40^\circ=180^\circ$

$x = 75°$

8. $x=\frac{1}{2}\left[(180^\circ-110^\circ)+(180^\circ-90^\circ)\right]$

$=\frac{1}{2}(70^\circ+90^\circ)=80^\circ$



Let P be the centre of a circle touching l and m. Clearly, AP = BP.

Hence, P lies on angle bisector of $\angle AOB$. Hence, locus of P will be the angle bisectors of the angles formed by these intersecting lines.

9. $\angle PQR=180^\circ-150^\circ=30^\circ$

$\angle PRQ=90^\circ$ (Angle of a semicircle)

$\angle RPQ+90^\circ+30^\circ=180^\circ$

$\Rightarrow \angle RPQ=60°$

10. $\angle OAB=\angle OBA(\because OA=OB)$

$\angle OAB = 35°$

Similarly, $\angle AOC = 25°$

$\therefore \angle x=35°+25°=60°$

12. Use $PA\times PB=PC\times PD$

$4 \times (7 - 4) = 6 \times PC$

$\Rightarrow$ PC = 2 cm

CD = PC + PD = 2 + 6 = 8 cm.

13. Use $PA\times PB=PC\times PD$

$\Rightarrow (4+3)\times 3=14\times PD \Rightarrow PD = 1.5$ cm

$\Rightarrow CD=PC-PD=14-1.5=12.5$ cm.

14. Let OL = x.

Then OM$(17-x)$

Also LB = 5 cm,

MD = 12 cm.

Then $x^2+25=r^2$ and $(17-x)^2+144=r^2$

Solving these we get

x = 12 cm and r = 13 cm

Thus, diameter = 2 × 13 = 26 cm.

15. $x+42^\circ+90^\circ=180^\circ \Rightarrow x=48°$

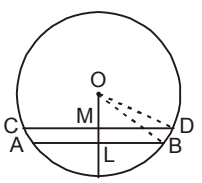
18. $\angle ACB=\frac{1}{2}\angle AOB=\frac{1}{2}\times 60^\circ=30^\circ$

21. Given, chord AB = 5 cm, chord CD = 11 cm and AB ∥ CD

Perpendicular distance ML between AB and CD = 3 cm

To find. Radius of the circle.

Construction, Join OB, OD and draw perpendicular bisectors OL of AB and OM of CD



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Procedure. In rt. ΔOMD,

$OD^2 = MD^2 + OM^2$

(By Pythagoras Theorem)

Let, $OM = x$ cm

$\therefore \quad r^2 = \left(\frac{11}{2}\right)^2 + x^2$ ...(1)

And In rt. ΔOLB, $OB^2 = BL^2 + OL^2$

$\Rightarrow \quad r^2 = \left(\frac{5}{2}\right)^2 + (3+x)^2$ ...(2)

From (1) and (2), we get,

$$r^2 = \left(\frac{11}{2}\right)^2 + x^2 = \left(\frac{5}{2}\right)^2 + (3+x)^2$$

$$\Rightarrow \quad \frac{121}{4} + x^2 = \frac{25}{4} + 9 + x^2 + 6x$$

$$\Rightarrow \quad x^2 - x^2 + 6x = \frac{121}{4} - \frac{25}{4} - 9$$

$$\Rightarrow \quad 6x = \frac{121 - 25 - 36}{4} = \frac{60}{4} = 15$$

$$\Rightarrow \quad x = \frac{15}{6} \text{ cm} = \frac{5}{2} \text{ cm}$$

From (1), $r^2 = \left(\frac{11}{2}\right)^2 + \left(\frac{5}{2}\right)^2 = \frac{121+25}{4} = \frac{146}{4}$

or $r = \frac{\sqrt{146}}{2}$ cm.

22. Given. A circle with centre O, such that chord AB = 6 cm, chord CD = 8 cm

AB ∥ CD and radius of the circle = 5 cm

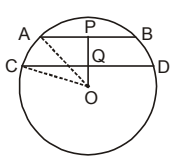
OP ⊥ AB and OQ ⊥ CD

To find. PQ

Construction. Join OA and OC

Procedure. AP = 1/2, AB = 3 cm, CQ = 1/2, CD = 4 cm

[Perpendicular from the centre of the circle bisects the chord]



In right ΔOPA, $OA^2 = OP^2 + AP^2$

[By Pythagoras Theorem]

$\Rightarrow \quad 5^2 = OP^2 + 3^2$

$\Rightarrow \quad 5^2 - 3^2 = OP^2 \quad \Rightarrow \quad 25 - 9 = OP^2$

$\Rightarrow \quad 16 = OP^2 \quad \Rightarrow \quad 4 = OP$

In right ΔOQC, $OC^2 = OQ^2 + CQ^2$

[By Pythagoras Theorem]

$5^2 = OQ^2 + 4^2$

$\Rightarrow \quad 5^2 - 4^2 = OQ^2 \quad \Rightarrow \quad 25 - 16 = OQ^2$

$\Rightarrow \quad 9 = OQ^2 \quad \Rightarrow \quad 3 = OQ$

$\therefore \quad PQ = OP - OQ = 4 - 3 = 1$ cm.

23. Given. Two circles touch internally at S, A and B be the centres of the bigger and smaller circles, respectively. The perpendicular bisector PQ bisects AB and meets the circle at P and Q.

To find PQ

Construction. Join PA, ABS

Procedure. With given radii, we find

AS = 5 cm

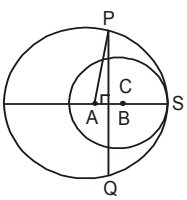
BS = 3 cm

AB = 5 – 3 = 2 cm and AC = 1 cm

[⊥ bisector bisects the chord]

PA = radius of bigger circle = 5 cm

In the right triangle ACP,



$PC^2 = PA^2 - AC^2$

[By Pythagoras Theorem]

$\Rightarrow \quad PC^2 = (5)^2 - (1)^2$

$\Rightarrow \quad PC^2 = 25 - 1 = 24$

$\Rightarrow \quad PC = \sqrt{24} \Rightarrow PC = 2\sqrt{6}$

$\therefore \quad PQ = 2PC = 4\sqrt{6}$ cm.

24. Given, AB and CD are two parellel chords of a circle, which are on opposite sides of the centre.

AB = 10 cm, CD = 24 cm

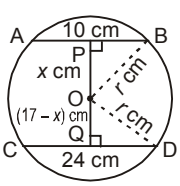
Distance between AB = CD = 17 cm

To find. Radius = ?

Construction. Draw OP ⊥ AB and OQ ⊥ CD. Join OB and OD.

Procedure. Since AB ∥ CD and OP ⊥ AB, OQ ⊥ CD

∴ Points P, O and Q are collinear.



Let, $OP = x$ cm

Then, $OQ = (17 - x)$ cm

$$PB = \frac{10}{2} = 5 \text{ cm}$$

($\because$ ⊥ from the centre bisects the chord)

$$QD = \frac{24}{2} = 12 \text{ cm}$$

($\because$ ⊥ from the centre bisects the chord)

In rt. ΔOPB, $r^2 = x^2 + 5^2$ ...(1)

(By Pythagoras Theorem)

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In rt. ΔOQD, $r^2 = (17 - x)^2 + 12^2$ ...(2)

From (1) and (2), we have

$x^2 + 25 = (17 - x)^2 + 12^2$

$\Rightarrow$ $x^2 + 25 = 289 + x^2 - 34x + 144$

$\Rightarrow$ $x^2 - x^2 + 34x = 289 + 144 - 25$

$\Rightarrow$ $34x = 408$

$\Rightarrow$ $x = 12$ cm

Using the value of x in (1), we get,

$r^2 = 12^2 + 5^2 = 144 + 25 = 169$

$\therefore$ Radius, $r = 13$ cm. ($\because$ radius can't be –ve)

25. Given, AB and CD are two parallel chords. AB = 8 cm, CD = 6 cm, radius = 5 cm.

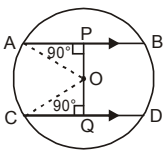
To find. PQ

Construction. Join OA, OC, where O is the centre of the circle

Procedure. AP = PB = 4 cm ...[$\because$ AB = 8 cm]

CQ = QD = 3 cm ...[$\because$ CD = 6 cm]

[$\because$ $\perp$ from the centre of a circle on any chord of the circle bisects it]



In rt. ΔOAP, OA = OC = radii of the circle = 5 cm

$OP^2 = OA^2 - AP^2$

[By Pythagoras Theorem]

$= (5)^2 - (4)^2 = 25 - 16 = 9$

$\Rightarrow$ OP = 3

In rt. ΔOCQ, $OQ^2 = OC^2 - CQ^2$

[By Pythagoras Theorem]

$(5)^2 - (3)^2 = 25 - 9 = 16$

$\Rightarrow$ OQ = 4

$\therefore$ PQ = PO + OQ = 3 + 4 = 7 cm.

Tangent

Secant

A line which interesects a circle in two distinct points is called a **secant** of the circle. In the fig. the line l intersects the circle in two distinct points A and B. The line l is a secant to the circle.

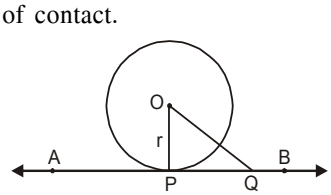
Tangent

A tangent to a circle is a line that intersects the circle at exactly one point. The point at which it meets the circle is called its point of contact and the line (tangent) is said to touch the circle at this point. In the figure, the line l meets the circle at only point A. Here A is the point of contact.

Some Important theorems on tangent

Theorem 1: *A tangent to a circle is perpendicular to the radius throught the point of contact.*

Given: A tangent AB to a circle C(O, r) with the point P as its point of contact.



To prove: OP $\perp$ AB.

Construction: Let Q be any point other that P, an AB. join OQ.

Proof: $\because$ Q is a point on the tangent AB other than the point of contact P.

$\therefore$ Q lies in the exterior of the circle.

$\therefore$ OQ > OP

i.e., OP < OQ

Thus, of all the segments that can be drawn from the centre O to any point on the line AB, OP is the shortest.

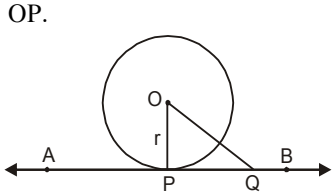
We know that the shortest segment that can be drawn from a given point to a given line perpendicular from the given point to the given line.

Hence OP $\perp$ AB.

Theorem 2: (Converse of theorem 1)

A line drawn through the end of a radius and perpendicular on it is tangent to the circle.

Given: A radius OP of a circle C(O, r) and a line APB perpendicular to OP.



To prove: AB is the tangent to the circle at A.

Proof: Take a point Q, different from P, on line AB, since OP $\perp$ AB, OQ > OP.

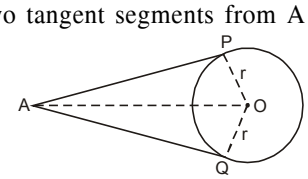
$\therefore$ The point Q lies outside the circle (since OP is the shortest line segment from O to AB).

Thus every point on the line AB, other P, lies outside the circle and therefore AB meets the circle only at the point P.

Hence AB is a tangent to the circle.

Theorem 3: *The lengths of the two tangents drawn from an external point to a circle are equal.*

Given: A is an external point to the circle C(O, r). AP and AQ are two tangent segments from A to the circle.



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To prove: AP = AQ.

Construction: Draw line segments AP, OP and OQ.

Proof: A tangent to a circle is perpendicular to the radius through the point of contact.

$\therefore \quad \angle OPA = \angle OQA = 90°$

Now in right Δs OPA and OQA,

OP = OQ [each = r]

OA = OA [common]

$\therefore \quad \Delta OPA \cong \Delta OQA$ [by RHS congruence rule]

$\therefore \quad AP = AQ$ [c.p.c.t.c.]

Common Tangents to Two circles

(*i*) Where the two circles neither intersect nor touch each other, there are FOUR common tangents, two of them are transverse & the others are direct common tangents.

(*ii*) When they intersect there are two common tangents, both of them being direct.

(*iii*) When they touch each other:

(*a*) Externally: there are three common tangents, two direct and one is the tangent at the point of contact.

(*b*) Internally: only one common tangent possible at their point of contact.

(*iv*) Length of an external common tangent & internal common tangent to the two circles is given by:

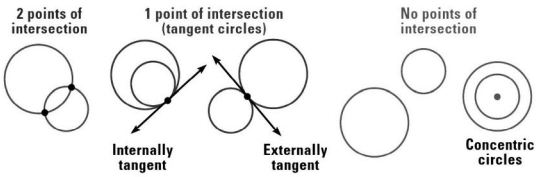
$$L_{ext} = \sqrt{d^2 - (r_1 - r_2)^2} \ \& \ L_{int} = \sqrt{d^2 - (r_1 + r_2)^2}$$

Where d = distance between the centres of the two circles. r_1 & r_2 are the radii of the two circles.

(*v*) The direct common tangents meet at a point which divides the line joining centre of circles externally in the ratio of their radii.

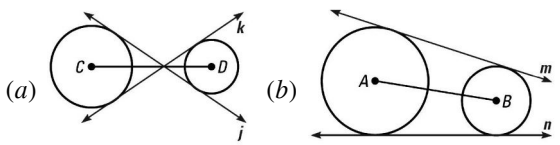
Transverse common tangents meet at a point which divides the line joining centre of circles internally in the ratio of their radii.

In a plane, two circles can intersect in two points, one point, or no points. Coplanar circles that intersect in one point are called **tangent circles.** Coplanar circles that have a common center are called **concentric.**



A line or segment that is tangent to two coplanar circles is called a **common tangent.** A *common internal tangent* intersects the segment that joins the centers of the two circles. A *common external tangent* does not intersect the segment that joins the centers of the two circles.

Example: Tell whether the common tangents are internal or external.

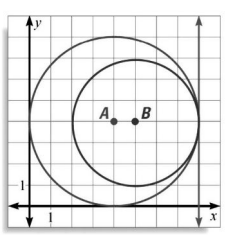


Solution: (*a*) The lines j and k intersect $\overline{CD}$, so they are common internal tangents.

(*b*) The lines m and n do not intersect $\overline{AB}$, so they are common external tangents.

In a plane, the **interior of a circle** consists of the points that are inside the circle. The **exterior of a circle** consists of the points that are outside the circle.

Example: Give the center and the radius of each circle. Describe the intersection of the two circles and describe all common tangents.



Solution: The center of $\odot A$ is A(4, 4) and its radius is 4. The center of $\odot B$ is B(5, 4) and its radius is 3. The two circles have only one point of intersection. It is the point (8, 4). The vertical line x = 8 is the only common tangent of the two circles.

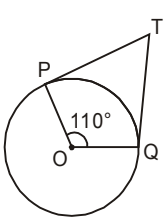
EXERCISE

1. From a point Q, the length of the tangent to a circle is 24 cm and the distance from the centre is 25 cm. The radius of the circle is

A. 7 cm B. 12 cm

C. 15 cm D. 24.5 cm

2. In the given figure, if TP and TQ are the two tangents to a circle with centre O and that $\angle POQ = 110°$, then $\angle PTQ$ is equal to



A. 60° B. 70°

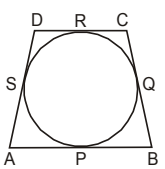
C. 80° D. 90°

3. If tangents PA and PB from a point P to a circle with centre O are inclined to each other at angle of 80°, then $\angle POA$ is equal to

A. 50° B. 60°

C. 70° D. 80°

4. In Fig., a circle touches all the four sides of a quadrilateral ABCD whose sides AB = 6 cm, BC = 7 cm and CD = 4 cm. Find AD



A. 2 cm B. 5 cm

C. 3 cm D. 4 cm

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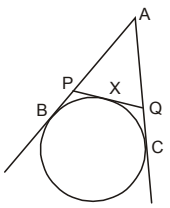
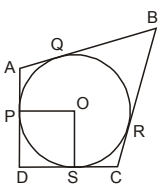
5. If AB, AC, PQ are tangents in the figure and AB = 5 cm. The perimeter of ΔAPQ is



A. 8 cm B. 6 cm
C. 10 cm D. 5 cm

6. In Fig., a circle is inscribed within a quadrilateral ABCD. Given that BC = 38 cm, BQ = 27 cm and DC = 25 cm and that AD is perpendicular to DC. The radius of the circle is

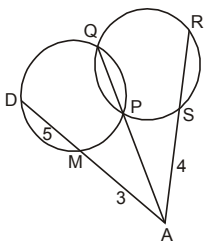


A. 10 cm B. 14 cm
C. 8 cm D. 12 cm

7. Two tangents are drawn to a circle from an external point A, touching the circle at the points P and Q. A third tangent intersects segment AP at B and segment AQ at C and touches the circle at R. If AQ = 10 units, then the perimeter of ΔABC (in units) is

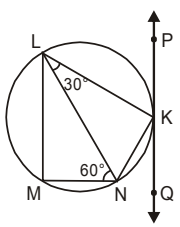
A. 22.0 B. 20.5
C. 20.0 D. 40.0

8. In Fig., two circles intersect each other at points P and Q. From A on line PQ, secant AMD for one circle and secant ASR for the second one are drawn. If AM = 3, MD = 5 and AS = 4, determine SR.



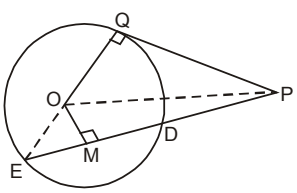
A. 2 cm B. 4 cm
C. 3 cm D. 1 cm

9. In the figure, KLMN is a cyclic quadrilateral and PQ is a tangent to the circle at K. If LN is a diameter of the circle. ∠KLN = 30° and ∠MNL = 60°. Determine ∠QKN



A. 30° B. 60°
C. 90° D. 100°

10. In the given Fig., PQ is tangent and O is the centre of the circle. Find EP is OP = 21, OQ = 9 and OM $\sqrt{80}$.



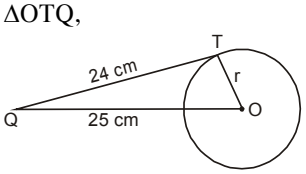
A. 10 B. 20
C. 30 D. 40

ANSWERS

1	2	3	4	5	6	7	8	9	10
A	B	A	C	C	B	C	A	A	B

EXPLANATORY ANSWERS

1. In rt. ∠*d* ΔOTQ,



$OT = \sqrt{OQ^2 - OT^2}$

$= \sqrt{25^2 - 24^2} = \sqrt{625 - 576} = \sqrt{49} = 7$ cm.

2. Since ∠POQ + ∠PTQ = 180°

[∵ ∠OPT = 90°, ∠OQT = 90°]

⇒ 110° + ∠PTQ = 180°

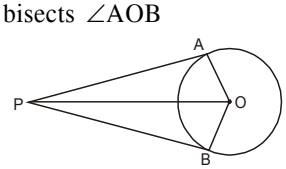
⇒ ∠PTQ = 180° − 110° = 70°.

3. Since ∠APB = 80°

∠AOB = 180° − 80° = 100°

∠PAO = ∠PBO = 90°

Since OP bisects ∠AOB



$\angle AOP = \frac{1}{2}(100°) = 50°$ *i.e.* ∠POA = 50°.

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4. AD = AS + DS = AP + DR

[$\because$ AS = AP and DS = DR]

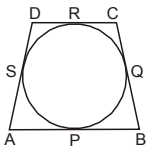
= (AB − BP) + (CD − RC)

= AB + CD − (BP + RC)

= AB + CD − (BQ + CQ)

[$\because$ BP = BQ, RC = CQ]

= AB + CD − BC = 6 + 4 − 7 = 3 cm.



5. Since AB and AC are the tangents from the same point A

$\therefore$ AB = AC = 5 cm

Similarly, BP = PX and XQ = QC

Perimeter of ΔAPQ

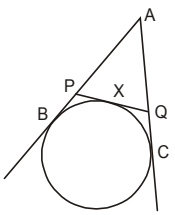
= AP + AQ + PQ

= AP + AQ + (PX + XQ)

= (AP + PX) + (AQ + XQ)

= (AP + BP) + (AQ + QC)

= AB + AC = 5 + 5 = 10 cm.



6. $\because$ Lengths of tangents drawn from an external point to a circle are equal

$\therefore$ BQ = BR = 27 cm

Let x be the radius of the circle

$\therefore$ OP = OS = PD = x

CR = BC − BR

= 38 − 27 = 11 cm

Now CS = CR = 11 cm

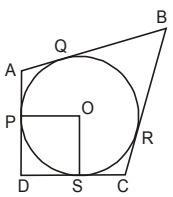
[$\because$ Length of tangents from an external point to a circle are equal]

$\therefore$ DS = CD − CS

= 25 cm − 11 cm = 14 cm

But DS = OP = x = 14 cm.

Hence radius = OP = 14 cm.



7. Since the tangents to a circle from an external point are equal in length

AP = AQ = 10 units

and BP = BR

CQ = CR

Adding these, we get,

BP + CQ = BR + CR = BC

Adding AB and AC to both sides, we get

BP + CQ + AB + AC = BC + AB + AC

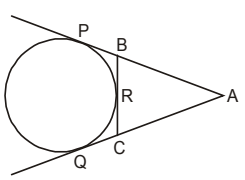
$\Rightarrow$ (BP + AB) + (CQ + AC) = AB + BC + AC

$\Rightarrow$ AP + AQ = Perimeter of ΔABC

$\Rightarrow$ (10 + 10) units = Perimeter of ΔABC

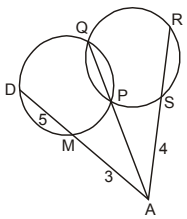
$\therefore$ Perimeter of ΔABC = 20 units.

$\therefore$ (*iii*) is the correct answer.



8. In the larger circle, chord QP and chord DM intersect each other at the point A outside the circle

$\therefore$ AM × AD = AP ...(1)



Again in the smaller circle, chord QP and chord RS intersect each other at the point A outside the circle.

$\therefore$ AS × AR = AP × AQ ...(2)

$\therefore$ AM × AD = AS × AR ...(3)

[From (1) and (2)]

Now AD = AM + MD

= 3 + 5 = 8

$\therefore$ From (3), 3 × 8 = 4 × AR

$\Rightarrow$ $AR = \frac{24}{4} = 6$

But AS + SR = AR

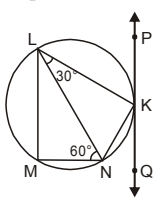
$\therefore$ 4 + SR = 6,

SR = 6 − 4 = 2.

9. KN is a chord through the point of contact K.

$\therefore$ $\angle QKN = \angle KLN = 30°$

[$\angle s$ in the alt. segment are equal]



10. Join OQ and OE

In ΔOPQ, $m\ \angle OQP = 90°$

$\therefore$ $OQ^2 + QP^2 = OP^2$ [By Pythagoras Theorem]

$\Rightarrow$ $(9)^2 + QP^2 = (21)^2$

$\Rightarrow$ $QP^2 = (21)^2 - (9)^2 = 360$

In rt. $\angle d$ ΔOME,

$OM^2 + EM^2 = OE^2$

$\Rightarrow$ $80 + (EM)^2 = (9)^2$

$\Rightarrow$ $EM^2 = 81 - 80 = 1$

$\Rightarrow$ $EM = +\sqrt{1} = 1$

$\therefore$ ED = 2EM = 2 × 1 = 2

Let EP = x

Then PQ^2 = PD × PE

[Tangent secant second point theorem]

$\therefore$ 360 = $(x - 2)x$

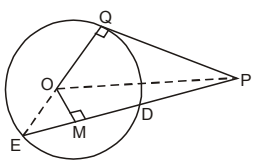
$\Rightarrow$ $x^2 - 2x - 360 = 0$

$\Rightarrow$ $(x - 20)(x + 18) = 0$

$\Rightarrow$ $x = 20, -18$

But $x \neq -18$

Hence EP = 20.



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CHAPTER 11

Mensuration

Triangle, Quadrilaterals, Regular Polygons

In mensuration we often have to deal with the problem of finding the areas and perimeters of plane figures.

Triangle

1. Perimeter = 3 × side
2. Area = $\frac{1}{2} \times \text{base} \times \text{height}$, or

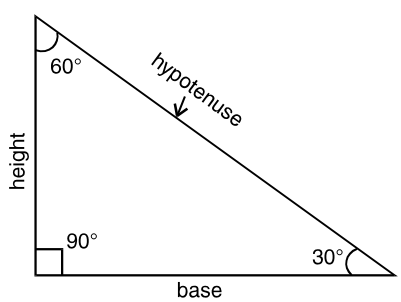
Area = $\sqrt{s(s-a)(s-b)(s-c)}$

where *a, b, c,* are the lengths of the sides of triangle and *s*

$= \frac{a+b+c}{2}$

Right Angled Triangle : It is one where one of the angles is right angle, i.e., 90°.

1. $(\text{Hypotenuse})^2 = (\text{Perpendicular})^2 + (\text{Base})^2$
2. Area = $\frac{1}{2} \times \text{Base} \times \text{Perpendicular}$



N.B. : 30-60-90 triangle is a special case of right angled triangle, where the three angles are equal to 30°, 60° and 90°.

Here,

3. Side opposite to the angle 30°

$= \frac{1}{2} \times \text{Hypotenuse}$

4. Side opposite to the angle 60°

$= \frac{\sqrt{3}}{2} \times \text{Hypotenuse}$

Equilateral Triangle : All three sides are equal in length and all three angles are equal to 60°

1. Area = $\frac{\sqrt{3}}{4} \times (\text{Side})^2$
2. Area = $\frac{(\text{Height})^2}{\sqrt{3}}$
3. Height = $\frac{\sqrt{3}}{2} \times \text{side}$
4. Perimeter = 3 × side

Isosceles Triangle : Two sides are equal in lengths.

1. Area = $\frac{b}{4}\sqrt{4a^2 - b^2}$

   where a = lengths of opposite sides

   b = length of unequal side
2. In an isosceles right triangle,

   (*a*) Hypotenuse = $\sqrt{2} \times$ congruent side (a)

   (*b*) Area = $\frac{1}{2} \times a^2$

   (*c*) Perimeter = $\sqrt{2} \times a\left(\sqrt{2}+1\right)$

Quadrilaterals

Rectangle:

1. Area = length(l) × breadth(b)
2. Perimeter = $2(l + b)$
3. Diagonal = $\sqrt{l^2 + b^2}$
4. Area of the path (inside of the rectangle)

   $= 2x\ (l + b - 2x)$

   where, x is the width of path.
5. Area of the path (Outside of the rectangle) = $2x\ (l + b + 2x)$

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Square:

1. Area = $(\text{Side})^2$
2. Perimeter = 4 × side
3. Diagonal = side $\times \sqrt{2}$
4. Area of path (outside of square) = $4x \times (a + x)$ [where a = side, x = width of path]
5. Area of path (inside of square) = $4x \times (a - x)$

Parallelogram: In parallelogram opposite sides are parallel and equal. The two diagonals are not always equal but they bisect each other at the point of intersection.

Area = Base × Height.

Trapezium : It is a quadrilateral whose one pair of opposite sides is parallel. Other two opposite sides are oblique.

1. Area = $\frac{1}{2} \times \text{Height} \times (\text{Sum of parallel sides})$. Here, height is the distance between the two parallel sides.
2. Median = $\left(\frac{1}{2} \times \text{Sum of parallel side}\right)$. Here, median is the segment joining the midpoints of oblique sides.
3. Height = $\frac{2}{K}\sqrt{s(s-k)(s-c)(s-d)}$ (where $k = a - b$, *i.e.,* the difference between the parallel sides and c and d are the two non-parallel sides.)

   Also $s = \frac{k+c+d}{2}$

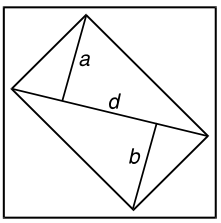
Rhombus : It is parallelogram whose all sides are equal and diagonals are bisect each other at right angle.

1. Area = $\frac{1}{2} \times$ Product of diagonals
2. Side = $\sqrt{\left(\frac{d_1}{2}\right)^2 + \left(\frac{d_2}{2}\right)^2}$, where d_1 and d_2 are diagonals
3. Perimeter = 4 × side
4. Area of a rhombus (with one side and one diagonal given)

   = diagonal × $\sqrt{(\text{side})^2 - \left(\frac{\text{diagonal}}{2}\right)^2}$
5. Other diagonal

   = $2 \times \sqrt{(\text{side})^2 - \left(\frac{\text{diagonal}}{2}\right)^2}$

Quadrilateral : Area = $\frac{1}{2} \times$ One diagonal ×



(Sum of perpendicular to it from the opposite vertices)

= $\frac{1}{2} \times d \times (a+b)$

Circle :

1. Diameter = 2 × Radius
2. Area = $\pi r^2 = \frac{\pi}{4}d^2$ [where d = diameter = $\sqrt{\frac{4A}{\pi}}$
3. Circumference = $2\pi r = \pi d$
4. Radius = $\frac{\text{Circumference}}{2\pi} = \frac{\sqrt{\text{Area}}}{\pi}$
5. Length of an Arc = $\frac{\theta}{360°} \times 2\pi r$
6. Area of sector = $\frac{\theta}{360°} \times \pi r^2 = \frac{1}{2} \times \text{Arc} \times r$
7. Area of the ring or circular path = π (R + r) (R − r)

Remember some tricks for plane figures.

(*i*) If area related each side is increased by a%, then

(a) Percentage increase in the area = $2a + \frac{a^2}{100}$

(b) $\frac{\text{New Area}}{\text{Old Area}} = \left(1 + \frac{a}{100}\right)^2$

(*ii*) If area related to each side is decreased by a%, then

(*a*) Percentage decrease in area = $2a - \frac{a^2}{100}$

(b) $\frac{\text{New Area}}{\text{Old Area}} = \left(1 - \frac{a}{100}\right)^2$

(*iii*) If the perimeter of a rectangle, circle, quadrilateral and triangle are same, then area of the circle will be the largest.

Polygon

1. Interior angle + Exterior angle = 180°
2. Each interior angle = $\left(\frac{2n-4}{n}\right) \times 90°$ where n = number of sides
3. Sum of Exterior angles = 360°
4. Perimeter = Number of sides × Length of side.

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5. For an equilateral triangle of side 'a' *(a)* radius of inscribed circle = $\frac{a}{2\sqrt{3}}$ and side of the triangle = $2\sqrt{3}r$, *(b)* radius of circumcircle = $\frac{a}{\sqrt{3}}$

6. Area of regular polygon = $\frac{1}{2}(\text{No. of sides})$ (Radius of the incribed circle)

7. Area of regular hexagon

$= \frac{3\sqrt{3}}{2}(\text{side})^2 = 2.598\ (\text{side})^2$

8. Area of a regular octagon

$= 2\left(\sqrt{2}+1\right)(\text{side})^2 = 4.828\ (\text{side})^2$

9. Area of cyclic quadrilateral A

$= \sqrt{s(s-a)(s-b)(s-c)(s-d)}$

where, $s = \frac{a+b+c+d}{2}$ and,

$\angle A + \angle C = \angle B + \angle D = 180°$

10. For circum-circle, if a is the length of each side of a regular polygon and R is the circum-radius, then

(*a*) $R = \frac{a}{2}\text{cosec}\left(\frac{180°}{n}\right)$

(*b*) Area of the polygon = $\frac{1}{4}na^2\cot\left(\frac{180°}{n}\right)$, or

(*c*) Area of the polygon

$= nR^2\sin\left(\frac{180°}{n}\right)\cos\left(\frac{180°}{n}\right)$

(*d*) Area of the circum-circle of n-sided regular polygon

$= \frac{\pi}{4}a^2\,\text{cosec}^2\left(\frac{180°}{n}\right)$

11. For in-circle, if a is the length of a side of a regular polygon and r is the radius of the in-circle, then

(*a*) $r = \frac{a}{2}\cot\left(\frac{180°}{n}\right)$

(*b*) Area of the polygon = $\pi r^2\cot\left(\frac{180°}{n}\right)$

(*c*) Area of the in-circle of an n-sided regular polygon

$= \frac{\pi}{4}a^2\cot^2\left(\frac{180°}{n}\right)$

(*d*) Radius of the in-circle of a regular hexagon = $\frac{\sqrt{3}}{4}\times a^2$

(*e*) Area of the in-circle = $\frac{3}{4}\pi a^2$

EXERCISE

1. A rectangle measures 50 cm × 25 cm. Its area is
A. 1150 sq. cm B. 1250 sq. cm
C. 1275 sq. cm D. 1280 sq. cm

2. A field is in the form of a square whose perimeter is 580 m. Area of this field is
A. 20025 sq. m B. 20225 sq. m
C. 30025 sq. m D. 19975 sq. cm

3. Find the area of the square whose each side measures 20 cm.
A. 300 sq. cm B. 380 sq. cm
C. 360 sq. cm D. 400 sq. cm

4. Area of a circle is 154 sq. cm. Its circumference will be
A. 44 cm B. 48 cm
C. 54 cm D. 68 cm

5. The base and the height of a triangle is 8 cm and 10 cm respectively. Its area will be
A. 40 sq. cm B. 20 sq. cm
C. 49 sq. cm D. 64 sq. cm

6. If it is given that the parallel sides of a trapezium are 15 m and 25 m while the distance between them is 10 m. its area will be
A. 150 sq. m B. 225 sq. m
C. 200 sq. m D. 270 sq. m

7. Perimeter of a rectangular field is 760 m and its length and breadth are in the ratio 11 : 8. Area of this rectangular field is
A. 35200 sq. m B. 34700 sq. m
C. 35600 sq. m D. 45200 sq. m

8. If side of a square is reduced by 50%, its area will be reduced by
A. 50% B. 75%
C. 80% D. 60%

9. If area of a square is equal to the area of a rectangle 6.4 m long and 2.5 m wide, then each side of this square measures
A. 8 m B. 5.4 m
C. 3.8 m D. 4 m

10. If perimeter of a right angled triangle is six times its smallest side, then the three sides of this triangle are in the ratio of
A. 13 : 5 : 12 B. 13 : 12 : 5
C. 12 : 5 : 13 D. 13 : 5 : 10

11. The perimeter of a square is 24 m and that of another is 32 m. Find the perimeter of a third square area of which is equal to sum of the areas of these two squares
A. 40 m B. 51 m
C. 37 m D. 42 m

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12. If each side of a square is doubled, its area will become
A. double B. four times
C. three times D. eight times

13. The difference between the areas of two squares is 225 sq. metres and each side of the bigger square is 25 metres. The side of the smaller square is
A. 18 m B. 21 m
C. 20 m D. 22 m

14. If the perimeter of an equilateral triangle is 72 cm, its area will be
A. $144\sqrt{3}$ sq. cm B. $142\sqrt{3}$ sq. cm
C. $154\sqrt{2}$ sq. cm D. $144\sqrt{2}$ sq. cm

15. The radii of two circles are 5 cm and 12 cm respectively. Find the radius of a circle which is equal in area to these two circles.
A. 15 cm B. 13 cm
C. 10 cm D. 8 cm

16. If the circumference of a circle is equal to the perimeter of a square, then their areas are in the ratio of
A. 14 : 11 B. 7 : 8
C. 14 : 13 D. 13 : 11

17. Three sides of a triangle are in the ratio of 17 : 15 : 8. If the perimeter of this triangle is 40 m, find its area
A. 50 sq. m B. 49 sq. m
C. 60 sq. m D. 69 sq. m

18. If the length of a rectangle is increased by 20% and width is decreased by 15%, then its area
A. decreased by 4% B. increases by 2%
C. decreases by 2% D. increases by 3%

ANSWERS

1	2	3	4	5	6	7	8	9	10
B	A	D	A	A	C	A	B	D	B
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**		
A	B	C	A	B	A	C	B		

EXPLANATORY ANSWERS

1. Area of the rectangle
$= l \times b = 50 \times 25 = 1250$ sq. cm

2. Perimeter of the square = 4 × side
According to question :
$4 \times \text{side} = 580 \Rightarrow \text{side} = \frac{580}{4} = 145$ m
$\therefore$ Area = $(\text{side})^2 = (145)^2 = 20025$ sq. m.

3. Area of the square = $(\text{side})^2 = (20)^2 = 400$ sq. cm.

4. Area of the circle= πr^2
$\therefore \quad \pi r^2 = 154$
$\Rightarrow \quad r^2 = \frac{154 \times 7}{22}$
$\Rightarrow \quad r^2 = 7 \times 7 \Rightarrow r = 7$ cm
$\therefore$ Circumference of the circle
$= 2\pi r = 2 \times \frac{22}{7} \times 7 = 44$ cm.

5. Area of the triangle
$= \frac{1}{2} \times \text{base} \times \text{height} = \frac{1}{2} \times 8 \times 10 = 40$ sq. cm.

6. Area of the trapezium
$= \frac{1}{2} \times (\text{sum of the parallel sides}) \times \text{distance between them}$
$= \frac{1}{2} \times (15 + 25) \times 10 = \frac{1}{2} \times 40 \times 10 = 200$ sq. m.

7. Suppose length and breadth of the rectangular field are $11x$ m and $8x$ m.
$\therefore$ Perimeter of the field
$= 2(11x + 8x) = 2 \times 19x = 38x$ m.
According to question :
Perimeter of the field = 760 m
$\therefore \quad 38x = 760 \Rightarrow x = \frac{760}{38} = 20$
$\therefore$ Length of the field = $11 \times 20 = 220$ m
Breadth of the field = $8 \times 20 = 160$ m
$\therefore$ Area of the field = $220 \times 160 = 35200$ sq.m.

8. Suppose side of the square = x m
In the first case :
Area of the square = x^2 sq. m.
In the second case :
On effecting 50% reduction in the side of the square,
Side of the new square = x – 50% of $x = \frac{x}{2}$ m
$\therefore$ Area of the new square = $\left(\frac{x}{2}\right)^2 = \frac{x^2}{4}$ sq.m.
$\therefore$ Reduction in area of the square
$= x^2 - \frac{x^2}{4} = \frac{3x^2}{4}$ sq. m.
$\therefore$ Percentage reduction = $\frac{3x^2/4}{x^2} \times 100 = 75\%$
Hence, area of the square will be reduced by 75%.

9. Area of the rectangle = $6.4 \times 2.5 = 16.00$ sq.m.
According to question :
Area of the square = Area of the rectangle
$\therefore$ Area of the square = 16 sq. m.
$\therefore$ Side of the square = $\sqrt{16} = \sqrt{4 \times 4} = 4$ m.

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10. Suppose, the three sides of the triangle are a, b and c and a is the largest while c is the smallest side of the triangle.

$\therefore \quad a^2 = b^2 + c^2 \quad ... (i)$

Perimeter of the triangle = $a + b + c$

According to question :

$(a + b + c) = c \times 6$

$\Rightarrow \quad a + b = 5c \quad ... (ii)$

From equation *(i)*, $a^2 - b^2 = c^2$

$\Rightarrow (a + b)(a - b) = c^2$

$\Rightarrow \quad 5c(a - b) = c^2$

$\Rightarrow \quad a - b = \frac{c}{5} \quad [\because a + b = 5c] \quad ... (iii)$

From equation *(ii)* and *(iii)*,

$a + b = 5c,\ a - b = \frac{c}{5}$

$\Rightarrow \quad 2a = 5c + \frac{c}{5}$

$= \frac{26c}{5} \Rightarrow a = \frac{26c}{10} = \frac{13}{5}c$

$\Rightarrow \quad a : c = 13 : 5$

on substituting the value of a in equation *(ii)*

$b = 5c - \frac{13c}{5} = \frac{12c}{5}$

$\Rightarrow \quad b : c = 12 : 5$

$\therefore \quad a : b : c = 13 : 12 : 5$

Hence, the three sides of the right angled triangle are in the ratio of 13 : 12 : 5.

11. Perimeter of the 1st square = 24 m

$\therefore$ Side of the 1st square = $\frac{24}{4}$ = 6 m

Perimeter of the 2nd square = 32 m

$\therefore$ Side of the 2nd square = $\frac{32}{4}$ = 8 m

According to question :

Area of the third square = Area of the first two squares

$\therefore$ Area of the third square = Areas of the 1st square + Area of the 2nd square

$= 6^2 + 8^2 = 36 + 64 = 100$ sq. m.

$\therefore$ Side of the third square = $\sqrt{100}$ = 10 m

$\therefore$ Perimeter of the third square

$= 4 \times$ side $= 4 \times 10 = 40$ m.

12. In the first case:

Side of the square = x m

$\therefore$ Area of the square = x^2 sq. m

In the second case:

Side of the square = $2x$ m.

$\therefore$ Area of the square = $(2x)^2 = 4x^2$ sq. m

Hence, it is clear that if side of a square is doubled, its area becomes four times.

13. Suppose side of the smaller square = x m

$\because$ Area of the bigger square = $(25)^2 = 625$ sq. m

And area of the smaller square = x^2 sq. m

According to question :

Differene between the areas of two squares

= 225 sq. m

$\therefore \quad 625 - x^2 = 225$

$\Rightarrow \quad x^2 = 625 - 225 = 400$

$\Rightarrow \quad x = \sqrt{400} = 20$ m

$\therefore$ Side of the smaller side = 20 m.

14. Suppose side of the equilateral triangle = x cm

$\therefore$ Perimeter of the triangle = $3x$ cm

According to question :

$3x = 72 \Rightarrow x = \frac{72}{3} = 24$ cm.

$\therefore$ Area of the equilateral triangle

$= \frac{\sqrt{3}}{4} \times x^2 = \frac{\sqrt{3}}{4} \times (24)^2$

$= 144\sqrt{3}$ sq. cm.

15. $\because$ Radius of the first circle = 5 cm

$\therefore$ Area of the first circle = $\pi \times 5^2 = 25\pi$ sq. cm and Radius of the second circle = 12 cm

$\therefore$ Area of the second circle

$= \pi \times 12^2 = 144\pi$ sq. cm

According to question :

Area of the new circle

= Sum of the areas of the two circles

$\therefore$ Area of the new circle

$= 25\pi + 144\pi = 169\pi$ sq. cm $= \pi(13)^2$ sq. cm

Hence, it is clear that the radius of the new circle will be 13 cm.

16. Suppose radius of the circle = R cm

And side of the square = x cm

$\therefore$ Circumference of the circle = 2πR cm

and Perimeter of the square = $4x$ cm

According to question :

$2\pi R = 4x \Rightarrow R = \frac{2x}{\pi}$

$\therefore$ Ratio between the areas of the circle and the square

$= \pi R^2 : x^2$

$\Rightarrow x \times \left(\frac{2x}{\pi}\right)^2 : x^2 \Rightarrow \frac{4x^2}{\pi} : x^2 \Rightarrow 4 : \pi : \Rightarrow 4 : \frac{22}{7}$

$\Rightarrow \quad 14 : 11.$

18. Suppose the length and the width of the rectangle are x metre and y metre respectively.

$\therefore$ Area of the rectangle = xy sq. metre

According to question :

On effecting 20% increase in the length and 15% decrease in the width :

Length of the new rectangle

= x + 20% of x = 1.2 x metre

Width of the new rectangle

= y – 15% of y = .85 y metre

$\therefore$ Area of the new rectangle

$= 1.2x \times .85y = 1.020\ xy$ sq. metre

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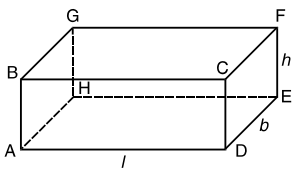
Prism; Right Circular Cone; Right Circular Cylinder; Sphere; Hemisphere; Right Pyramid; Rectangular Parallelepiped

In mensuration we often have to deal with the problem of finding the volume of solid figure.

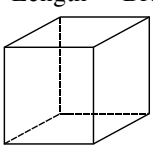
Cuboid : A cuboid has six faces, each one a ractangle. It has 12 edges. For example, a rectangular brick.



Let length = l, Breadth = b and height = h, then,

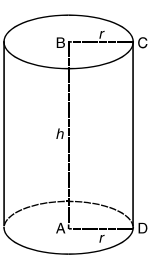
1. Volume = (Length × Breadth × Height)
2. Whole surface = $2(lb + bh + lh)$
3. Diagonal = $\sqrt{l^2 + b^2 + h^2}$
4. Area of 4 walls of a room = $2 \times h\ (l + b)$

Cube : In a cube, Length = Breadth = Height



1. Volume = $(l)^3$
2. Length = $\sqrt[3]{\text{Volume}}$
3. Whole Surface area = $6\ l^2$
4. Diagonal = $l \times \sqrt{3}$
5. Lateral surface area = $4\ l^2$

Cylinder :



1. Volume = $\pi r^2 h$
2. Curved surface Area = $2\pi rh$
3. Total surface area = $2\pi r(r + h)$
   where r = radius, h = height
4. Curved surface of hollow cylinder
   $= 2\pi h\ (r_1 + r_2)$
5. Total surface of hollow cylinder
   $= 2\pi h\ (r_1 + r_2) + 2\pi\ (r_1^2 - r_2^2)$
6. Volume of hollow cylinder

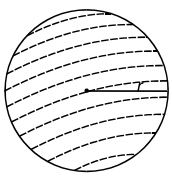
   $= \pi h\left(r_1^2 - r_2^2\right)$

   where r_1 = outer radius
   r_2 = inner radius

Spherical Cell :

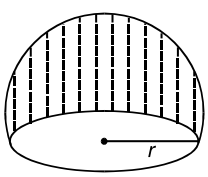
1. Volume = $\frac{4}{3}\pi\left(R^3 - r^3\right)$
2. Total surface area= $4\pi(R^2 - r^2)$
   where R = Outer radius
   r = Inner radius

Sphere



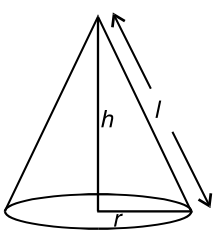
1. Volume = $\frac{4}{3}\pi r^3$
2. Surface area = $4\pi r^2$

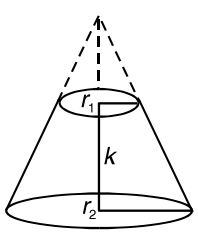
Semi-Sphere



1. Volume = $\frac{2}{3}\pi r^3$
2. Curved surface area = $2\pi r^2$
3. Total surface area = $3\pi r^2$

Cone :





1. Slant height $(l) = \sqrt{r^2 + h^2}$
2. Volume = $\frac{1}{3}\pi r^2 h$
3. Curved surface area = πrl
4. Total surface area = $\pi r\ (l + r)$
5. If the thickness of the frustum of a cone be k and the radii of its ends are r_1 and r_2, then
   (i) Slant height of the frustum of a cone
   $= \sqrt{K^2 + (r_1 - r_2)^2}$
   (ii) Curved surface of the frustum = $\pi(r_1 + r_2)\ l$.
   (iii) Volume = $\frac{\pi K}{3}\left(r_1^2 + r_1 r_2 + r_2^2\right)$

Right Pyramid

1. Volume = $\frac{1}{3}$(area of the base) × height
2. Lateral surface area
   $= \frac{1}{2}$(Perimeter of the base) × Slant height
3. Total surface area = 2 (Area of one end) + Lateral surface area

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Right Prism

1. Volume = Area of the base × Height
2. Lateral surface Area = Perimeter of the Base × Height
3. Total surface Area = 2 (Area of one end) + Lateral surface area.

Rectangular Parallelepiped

Sometimes also referred to as "Rhomboid", a parallelepiped is a 3-D shape moulded by 6 parallelograms. If observed more carefully, as a cube relates to a square, a cuboid relates to a rectangle, the same way a parallelepiped is related to parallelogram.

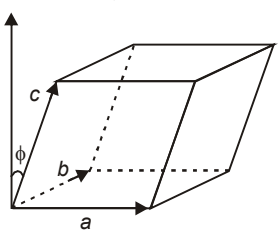
We have the following formula for finding out the volume, lateral surface area and surface area of rectangular parallelepiped.

The formulas are:

Volume = abc

Surface area = 2ab + 2bc + 2ac

Diagonal = $\sqrt{a^2 + b^2}$



Example: Counting 38 cu. ft. of coal to a ton, how many tons will a coal bin 19 ft. long, 6 ft. wide, and 9 ft. deep contain, when level full?

Solution: The volume of a rectangular parallelepiped is given by the formula

$$V = L \times W \times H$$

Substitute the values of length, width and height of a tin, we have

$$V = L \times W \times H$$
$$V = (19ft)\ (6R.)\ (9\ ft.)$$
$$V = 1026\ R^3$$

The density of a substance is given by the formula

$$\rho = \frac{W}{V}$$

where, ρ is the density, W is the weight, and V is the volume of a substance respectively.

$$W = V \times \rho$$

Therefore, the weight of a coal in a bin is:

$$W = (1026\,R^3)\left(\frac{1\ ton}{38n^3}\right)$$

$$W = 27\ tons.$$

Example: The base face of a parallelepiped has opposite sides measuring 5 inches and 10 inches. The height of the parallelepiped is 4 inches. Find the cost of painting its walls from outside at a cost of INR 1.5 per square inch.

Solution: We need to find the lateral surface area first, therefore;

LSA = Perimeter of base × height

LSA = 2 (5 + 10) + 6

LSA = 180 sq. inch

Cost of painting = Lateral surface area × cost per square inch

Cost of painting the walls = 180 × 1.5 = ₹ 270.

EXERCISE

1. A solid in the form of a cuboid is 4 cm × 3 cm × 2 cm. Its volume will be
A. 20 cu cm B. 22 cu cm
C. 28 cu cm D. 24 cu cm

2. A reservoir is 3 m long, 2 m wide and 1 m deep. Its capacity in litres is
A. 8000 litres B. 10000 litres
C. 6500 litres D. 6000 litres

3. Surface area of a cube is 1014 sq. cm. Its volume will be
A. 2197 cu cm B. 2297 cu cm
C. 2179 cu cm D. 2117 cu cm

4. If the volumes of two cubical blocks are in the ratio of 8 : 1, what will be the ratio of their edges?
A. 1 : 2 B. 2 : 1
C. 4 : 1 D. 2 : 3

5. Two spheres have their surface areas in the ratio 9 : 16. Their volumes are in the ratio of
A. 64 : 27 B. 27 : 64
C. 16 : 27 D. 11 : 27

6. The length of the longest rod that can be place in a room 12 m long, 9 m broad and 8 m high is
A. 17 m *(b)* 18 m
C. 25 m D. 16 m

7. The radius and the height of a right circular cone are in the ratio of 3 : 5. If its volume is 120π cu m, its slant height is
A. $3\sqrt{34}$m B. $2\sqrt{28}$m
C. $2\sqrt{44}$m D. $2\sqrt{34}$m

8. Circumference of the base of a cylinder is 88 cm and height of the cylinder is 42 cm. Its volume is
A. 25872 cu cm B. 28572 cu cm
C. 25870 cu cm D. 22584 cu cm

9. It fwo cubes each of 10 cm side are kept close to each other, then the cuboid so formed will have surface area equal to
A. 1200 sq. cm B. 5000 sq. cm
C. 1000 sq. cm D. 1250 sq. cm

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10. A rectangular piece of paper is 30 cm long and 20 cm wide. How many ways can be adopted if one wants to give this rectangular piece of paper a cylindrical form?
A. Three B. Two
C. One D. Four

11. In the above question, the cylinders formed will have their volumes in the ratio of
A. 2 : 3 B. 3 : 1 : 1
C. 3 : 2 D. 1 : 3 : 1

12. If a solid sphere of 3 cm radius is melted and recast into a right circular cone whose base radius is same as that of the sphere, the height of the cone will be
A. 8 cm B. 12 cm
C. 6 cm D. 5 cm

13. Diameter of a roller is 2.4 m and it is 1.68 m long. If it takes 1000 complete revolutions once over to level a field, the area of the field is
A. 12672 sq. m B. 12671 sq. m
C. 12762 sq. m D. 11768 sq. m

14. If each edge of a cube is increased by 10%, then by how much percent will the surface area of this cube be increased?
A. 21% B. 18%
C. 15% D. 20%

15. Height and base radius of a solid cylinder are 14 m and 4 m respectively. It is melted and recast into a solid cone of the same base radius as that of the cylinder, what will be the height of the cone?
A. 21 m B. 42 m
C. 48 m D. 54 m

16. A room is in the form of a cube of side 10 m. How many bales of cotton can be kept in it if each bale covers 5 cu m space?
A. 100 B. 175
C. 200 D. 225

17. Three cubes having side 2 cm, 3 cm respectively are melted together to form a new cube. The side of the new cube will be
A. 3.526 cm B. 4.628 cm
C. 4.626 cm D. 4.528 cm

18. If base diameter of a cylinder is increased by 50%, then by how much percent its height must be decreased so as to keep its volume unaltered?
A. 45.56% B. 55.56%
C. 50.16% D. 62.33%

19. The surface area of a cube is 600 sq. m. Its diagonal is
A. $10\sqrt{3}$ cm B. $5\sqrt{3}$ cm
C. $4\sqrt{2}$ cm D. $10\sqrt{2}$ cm

20. The base diameter of a conical tomb is 28 m and its slant height is 50 m. Find the cost of white-washing its curved surface at the rate of 80 paise per sq. m?
A. ₹ 1860 B. ₹ 1760
C. ₹ 1950 D. ₹ 1875

ANSWERS

1	2	3	4	5	6	7	8	9	10
D	D	A	B	B	A	D	A	C	B
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
C	B	A	A	B	C	C	B	A	B

EXPLANATORY ANSWERS

1. Volume of the cuboid
$= l \times b \times h = 4 \times 3 \times 2 = 24$ cu. cm.

2. Volume of the reservoir
$= l \times b \times h = 3 \times 2 \times 1 = 6$ cu. cm
($\because$ 1 cu m = 1000 litre)
$\therefore$ Capacity of the reservoir
$= 6 \times 1000 = 6000$ litre.

3. Surface area of a cube $= 6 \times (\text{side})^2$
$\therefore \quad 6 \times (\text{side})^2 = 1014$
$\Rightarrow \quad (\text{side})^2 = \frac{1014}{6} = 169$
$\Rightarrow \quad \text{side} = \sqrt{169} = 13$ cm
$\therefore$ Volume of the cube $= (\text{side})^3 = (13)^3$
$= 2197$ cu cm.

4. Suppose sides of the two cubical blocks are a_1 and a_2 respectively
$\therefore$ Volume of the two cubical blocks will be $(a_1)^3$ and $(a_2)^3$ rspectively
According to question :
$$a_1^3 : a_2^3 = 8 : 1$$
$$\therefore \quad \frac{a_1^3}{a_2^3} = \frac{8}{1}$$
$$\therefore \quad \left(\frac{a_1}{a_2}\right)^3 = \left(\frac{2}{1}\right)^3 \Rightarrow a_1 : a_2$$
$$= 2 : 1$$
Therefore ratio of their edges = 2 : 1.

5. Suppose radii of the two spheres are r_1 and r_2 respectively.

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$\therefore$ Surface areas of the two spheres are $4\pi r_1^2$ and $4\pi r_2^2$ respectively

According to question :

$4\pi r_1^2 : 4\pi r_2^2 = 9 : 16 \Rightarrow r_1^2 : r_2^2 = 9 : 16$

$\Rightarrow \quad \frac{r_1^2}{r_2^2} = \frac{9}{16} \Rightarrow \left(\frac{r_1}{r_2}\right)^2 = \left(\frac{3}{4}\right)^2$

$\Rightarrow \quad r_1 : r_2 = 3:4 \Rightarrow \left(\frac{r_1}{r_2}\right)^3 = \left(\frac{3}{4}\right)^3$

$\Rightarrow \quad \frac{r_1^3}{r_2^3} = \frac{27}{64} \Rightarrow r_1^3 : r_2^3 = 27 : 64.$

Therefore ratio of their volumes

$$= \frac{4}{3}\pi r_1^3 : \frac{4}{3}\pi r_2^3 = r_1^3 : r_2^3 = 27 : 64$$

6. The longest rod that can be placed in the cuboidal room = Length of the diagonal =

$$\sqrt{l^2 + b^2 + h^2} = \sqrt{(12)^2 + (9)^2 + (8)^2}$$

$$= \sqrt{144 + 81 + 64} = \sqrt{289} = 17 \text{ m}$$

7. Suppose the base radius and the height of the right circular cone are $3x$ m and $5x$ m respectively.

$\therefore$ Volume of the cone

$$= \frac{1}{3}\pi r^2 h = \frac{1}{3}\pi (3x)^2 \times 5x \text{ cu m}$$

According to question :

Volume of the cone = 120π cu m (given)

$\therefore \quad \frac{1}{3}\pi \times 9x^2 \times 5x = 120\pi$

$\Rightarrow \quad x^3 = \frac{120 \times 3}{9 \times 5}$

$\Rightarrow \quad x^3 = 8 \Rightarrow x^3 = (2)^3$

$\Rightarrow \quad x = 2$ m

$\therefore$ The radius and the height of the cone will be $3 \times 2 = 6$ m and $5 \times 2 = 10$ m respectively.

$\therefore$ Slant height of the cone

$$= \sqrt{r^2 + h^2} = \sqrt{(6)^2 + (10)^2}$$

$$= \sqrt{36 + 100} = \sqrt{136} = 2\sqrt{34}\,\text{m}.$$

8. Suppose the base radius of the cylinder = r cm

$\therefore$ Circumference of the base of the cylinder = $2\pi r$ cm

According to question :

$$2\pi r = 88$$

$$\therefore \quad r = \frac{88}{2\pi} = \frac{88 \times 7}{2 \times 22} = 14 \text{ cm}$$

$\therefore$ Volume of the cylinder

$$= \pi r^2 h = \frac{22}{7} \times (14)^2 \times 42$$

$$= 22 \times 2 \times 14 \times 42$$

$$= 25872 \text{ cu cm.}$$

9. Candidates should note that in such type of questions where two cubes of equal edges are kept close to each other, only the length of the cuboid so form increases and breadth and height of the cuboid remain same as that of the cube.

$\therefore$ Length of the cuboid = Edge of the first cube + Edge of the second cube

$$= 10 + 10 = 20 \text{ cm}$$

$\therefore$ Surface area of the cuboid

$= 2(20 \times 10 + 10 \times 10 + 10 \times 20)$

$$= 2(200 + 100 + 200)$$

$$= 5 \times 500 = 1000 \text{ sq. cm.}$$

10. Obviously, two ways can be adopted if one wants to give the rectangular piece of paper a cylindrical form, *i.e.,*

1. *When the paper is bent towards its length.* In this case, the circumference of the base of the cylinder will be equal to the length of the rectangular piece of paper and the height of the cylinder will be equal to the breadth of the rectangular piece of paper.
2. *When the paper is bent towards its breadth.* In this case, the circumference of the base of the cylinder will be equal to the breadth of the rectangular piece of paper and the height of the cylinder will be equal to the length of the rectangular piece of paper.

11. In the first case :

$$2\pi r = 30$$

$$r = \frac{15}{\pi} \text{ cm and } h = 20 \text{ cm}$$

$\Rightarrow$ volume $(v_1) = \pi r^2 h$

$$= \frac{15 \times 15 \times 20}{\pi} = \frac{4500}{\pi} \text{ cu cm}$$

In the second case :

$2\pi r = 20 \Rightarrow r = \frac{10}{\pi}$ cm and $h = 30$ cm

$\therefore$ Volume $(v_2) = \pi r^2 h$

$$= \frac{10 \times 10 \times 30}{\pi} = \frac{3000}{\pi} \text{ cu cm}$$

$\therefore$ Ratio of the two volumes

$$= v_1 : v_2 = \frac{4500}{\pi} : \frac{3000}{\pi} = 3 : 2$$

12. Volume of the sphere of radius 3 cm

$$= \frac{4}{3}\pi (3)^3 = \frac{4}{3}\pi \times 27 \text{ cu cm}$$

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Suppose the height of the cone = h cm

$\therefore$ Volume of the cone having base radius equal to that of the sphere = $\frac{1}{3}\pi(3)^2 \times h$

$\because$ Volume of the cone = Volume of the sphere

$\therefore \quad \frac{1}{3}\pi(3)^2 \times h = \frac{4}{3}\pi \times 27 \Rightarrow h = 12$ cm

$\therefore$ Height of the cone = 12 cm.

13. Diameter of the roller = 2.4 m

$\therefore$ Radius of the roller = 1.2 m

And height (length) of the roller = 1.68 m

$\therefore$ Surface area of the roller

$= 2\pi rh = 2 \times \frac{22}{7} \times 1.2 \times 1.68 = 12.672$ sq. m

$\therefore$ In one complete revolution, the roller covers 2.672 sq. m.

$\therefore$ It will cover in 1000 revolutions = 12.672 × 1000 = 12672 sq. m

$\therefore$ Area of the field = 12672 sq. m.

14. The two edges which are included in surface area of the cube are increased by 10%.

$\therefore \quad x\% = y\% = 10\%$

and in case of percentage increase, values of x and y are positive

$\therefore$ Percentage increase in the surface area of the cube

$= \left(x + y + \frac{xy}{100}\right)\%$

$= \left(10 + 10 + \frac{10 \times 10}{100}\right)\% = 21\%.$

15. Volume of the solid cylinder

$= \pi r^2 h = \pi r^2 \times 14$ cu m

According to question :

Radius of the cone = Radius of the cylinder

$= r$ m = 4 m

and volume of the cone

= Volume of the cylinder

$\therefore \quad \frac{1}{3}\pi r^2 \times \text{height} = \pi r^2 \times 14$

$\therefore \quad$ Height = 14 × 3 = 42 m

$\therefore$ Height of the cone = 42 m.

16. Volume of the cubical room

$= (10)^3 = 1000$ cu m

Number of cotton bales which can be placed in the room

$= \frac{\text{Volume of the room}}{\text{Volume of each cotton bale}} = \frac{1000}{5} = 200.$

17. Edges of the three cubes are 2 cm, 3 cm and 4 cm respectively

$\therefore$ Their volumes will be $(2)^3 = 8$ cu cm, $(3)^3 = 27$ cu cm and $(4)^3 = 64$ cu cm respectively.

Volume of the new cube = Total volume of the three cubes

$\therefore$ Volume of the new cube

= 8 + 27 + 64 = 99 cu cm

$\therefore$ Side of the new cube = $\sqrt[3]{99} = 4.626$ cm.

18. Suppose the height of the cylinder should be decreased by H%

$\because$ Volume of a cylinder comprises two radii (*i.e.,* two edges) and one height (as the third edge). Radius is increased by 50%.

It means $x\% = y\% = 50\%$ and percentage decrease in the third edge (*i.e.,* height) = H%.

Therefore, $z\% = H\%$ and in case of percentage decrease value of z will be negative.

$\therefore$ Change in the volume of the cylinder

$= \left(x + y + (-z) + \frac{xy + y(-z) + (-zx)}{100} + \frac{xy(-z)}{100^2}\right)\%$

Since volume of the cylinder remains unchanged.

$\therefore \quad$ Change = 0%

$\therefore \quad \left(50 + 50 + (-H) + \frac{50 \times 50 - 50H - 50H}{100} + \frac{50 \times 50 \times (-H)}{100^2}\right)\%$

$\therefore$ 100 − H + 25 − H − .25H = 0

$\Rightarrow \quad 2.25H = 125$

$\Rightarrow \quad H = \frac{125}{2.25} = 55.56$

$\therefore$ Height of the cylinder should be decreased by 55.56%.

19. $\because$ Surface area of the cube = 6 × (side)^2

$\therefore \quad 6 \times (\text{side})^2 = 600$

$\Rightarrow \quad \text{side}^2 = 100$

$\Rightarrow \quad \text{side} = \sqrt{100} = 10$ cm

$\therefore$ Diagonal of the cube

$= \sqrt{3} \times \text{side} = \sqrt{3} \times 10 = 10\sqrt{3}$ cm.

20. $\because$ Area of the curved surface of the cone = πrl

(where r = radius of the cone and l = slant height of the cone)

$\therefore$ Area of the curved surface of the cone

$= \frac{22}{7} \times \frac{28}{2} \times 50 = 2200$ sq. m.

$\therefore$ Cost of whitewashing at 80 paise per sq. m

$= 2200 \times \frac{80}{100} = ₹\ 1760.$

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CHAPTER 12

Trigonometry

Trigonometrical Ratios; Degree and Radian Measures; Standard Identities; Complementary Angles

Measurement of Angles: In general, the angles are measured in degrees or in radians which are defined as follows:

***(a) Degrees*:** A right angle is divided into 90 equal parts and each part is called a degree. Thus a right angle is equal to 90 degrees. One degree is denoted by 1°.

A degree is divided into sixty equal parts and each part is called a minute and is denoted by 1'.

A minute is divided into sixty equal parts and each part is called a second and is denoted by 1″.

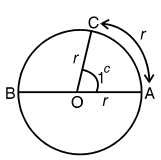
Thus, we have

1 right angle = 90° (read as 90 degrees)

1° = 60′ (read as 60 minutes)

1′ = 60″ (read as 60 seconds)

***(b) Radians*:** A radian is the angle subtended at the centre of a circle by an arc equal in length to the radius of the circle.



In the adjacent figure OA = OC = arc AC = r = radius of the circle, then measurement of $\angle$ AOC is one radian and is denoted by 1^c. Thus $\angle$ AOC = 1^c.

A Constant Number π: The ratio of the circumference to the diameter of a circle is always equal to a constant and this constant is denoted by the Greek letter π.

Thus π = circumference/diameter.

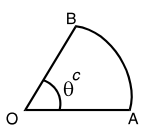
$\therefore$ If r is the radius of a circle, then its circumference = $2\pi r$.

The constant π is an irrational number and its approximate value is taken as 22/7.

Relation Between an Arc and an Angle: If s is the length of an arc of a circle of radius r, then the angle θ (in radians) subtended by this arc at the centre of the circle is given by $\theta = s/r$ or $s = r\theta$

i.e., arc = radius × angle in radians

Given in the figure,



$\angle$ AOB = $\frac{\text{arc ACB}}{r}$ (in radians)

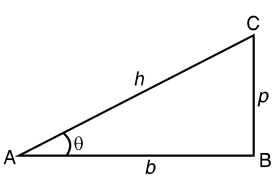
= $\frac{\pi r}{r}$ = π radians.

Thus we have, π radians = 180° = 2 right angles

or 1 radian = $\frac{180}{\pi}$ degrees = $\frac{180}{22}\times 7$ degrees = 57° 17' 44.8" (Appr.)

Sectorial Area: Let OAB be a sector having central angle θ^c and radius r. Then area of the sector OAB is given by $\frac{1}{2}r^2\theta$.

Trigonometrical Ratios: In a right angled triangle ABC, if $\angle$ CAB = θ, then BC = side opposite to the angle θ = Perpendicular = p (say), AC = side opposite to the right angle = Hypotenuse = h (say) and AB = b (say).



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The six trigonometrical ratios are given as follows:

$\sin\theta = p/h$, $\cos\theta = b/h$, $\tan\theta = p/b$.

(Also $\tan\theta = \sin\theta/\cos\theta$, $\operatorname{cosec}\theta = 1/\sin\theta$,

$\sec\theta = 1/\cos\theta$, $\cot\theta = 1/\tan\theta$,)

Basic Formulae Connecting Six Trigonometrical Ratios

The formulae connecting the six trigonometrical ratios are:

(i) $\sin^2\theta + \cos^2\theta = 1$ or $\cos^2\theta = 1 - \sin^2\theta$ or $\sin^2\theta = 1 - \cos^2\theta$.

(ii) $1 + \tan^2\theta = \sec^2\theta$ or $\sec^2\theta - \tan^2\theta = 1$

(iii) $1 + \cot^2\theta = \operatorname{cosec}^2\theta$ or $\operatorname{cosec}^2\theta - \cot^2\theta = 1$.

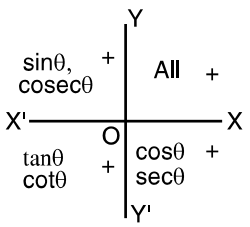
Sign of Trigonometrical Ratios:

1st quadrant $0 < \theta < 90°$,
all trigonometrical ratios +ve,

2nd quadrant $90° < \theta < 180°$,
only sin θ and cosec θ, +ve

3rd quadrant $180° < \theta < 270°$,
only tan θ and cot θ, +ve

4th quadrant $270° < \theta < 360°$,
only cos θ and sec θ, +ve.



Trigonometrical Ratios of Related Angles:

$\sin(-\theta) = -\sin\theta$	$\cos(-\theta) = \cos\theta$	$\tan(-\theta) = -\tan\theta$
$\sin(90° - \theta) = \cos\theta$	$\sin(180° + \theta) = -\sin\theta$	$\sin(270° + \theta) = -\cos\theta$
$\cos(90° - \theta) = \sin\theta$	$\cos(180° + \theta) = -\cos\theta$	$\cos(270° + \theta) = \sin\theta$
$\tan(90° - \theta) = \cot\theta$	$\tan(180° + \theta) = \tan\theta$	$\tan(270° + \theta) = -\cot\theta$
$\sin(90° + \theta) = \cos\theta$	$\sin(270° - \theta) = -\cos\theta$	$\sin(360° + \theta) = \sin\theta$
$\cos(90° + \theta) = -\sin\theta$	$\cos(270° - \theta) = -\sin\theta$	$\cos(360° + \theta) = \cos\theta$
$\tan(90° + \theta) = -\cot\theta$	$\tan(270° - \theta) = \cot\theta$	$\tan(360° + \theta) = \tan\theta$

Table giving sine, cosine and tangent of some angles less than 90°:

	0°	15°	18°	22.5°	30°	36°	45°	60°	67.5°	90°
sin	0	$\frac{\sqrt{6}-\sqrt{2}}{4}$	$\frac{\sqrt{5}-1}{4}$	$\frac{\sqrt{2-\sqrt{2}}}{2}$	$\frac{1}{2}$	$\frac{\sqrt{10-2\sqrt{5}}}{4}$	$\frac{1}{\sqrt{2}}$	$\frac{\sqrt{3}}{2}$	$\frac{\sqrt{\sqrt{2}+1}}{\sqrt{(2\sqrt{2})}}$	1
cos	1	$\frac{\sqrt{6}+\sqrt{2}}{4}$	$\frac{\sqrt{10+2\sqrt{5}}}{4}$	$\frac{\sqrt{\sqrt{2}+1}}{\sqrt{(2\sqrt{2})}}$	$\frac{\sqrt{3}}{2}$	$\frac{\sqrt{5}+1}{4}$	$\frac{1}{\sqrt{2}}$	$\frac{1}{2}$	$\frac{\sqrt{2-\sqrt{2}}}{2}$	0
tan	0	$2-\sqrt{3}$	$\frac{\sqrt{25-10\sqrt{5}}}{5}$	$\sqrt{2}-1$	$\frac{1}{\sqrt{3}}$	$\sqrt{5-2\sqrt{5}}$	1	$\sqrt{3}$	$\sqrt{2}+1$	not defined

Bounds of T-Ratios: Since $\sin^2\theta + \cos^2\theta = 1$, the absolute values of sin θ and cos θ can never be greater than 1.

Thus $0 \le |\sin\theta| \le 1$, $0 \le |\cos\theta| \le 1$,

i.e., $-1 \le \sin\theta$; $\cos\theta \le 1$, or $0 \le \sin^2\theta$;

$\cos^2\theta \le 1$.

Also $\sec\theta$; $\operatorname{cosec}\theta \ge 1$ or ≤ -1

i.e.,$\sec\theta$, $\operatorname{cosec}\theta$ can never lie between –1 and 1.

It should be noted that $-\infty < \tan\theta$; $\cot\theta < \infty$.

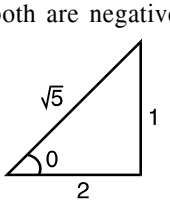
To Determine the Values of Other Trigonometrical Ratios when one Trigonometrical Ratio is given: If one of the *t*-ratio is given, the values of other *t*-ratios can be found by using formulae. For example, $\sin\theta = 1/3$. Since sine is positive in Q_1 or Q_2, we have

$\cos\theta = \sqrt{1-(1/9)}$

or $-\sqrt{1-(1/9)}$, *i.e.,* $2\sqrt{2}/3$

or $-2\sqrt{2}/3$ according to $\theta \in Q_1$ or $\theta \in Q_2$.

We can also find other ratios by forming right angled triangle, *e.g.,* Let $\tan\theta = 1/2$, $\pi < \theta < 3\pi/2$, then since θ in Q_3, sine and cosine both are negative,



$\therefore$ We have $\sin\theta = -1/\sqrt{5}$,

$\cos\theta = -2/\sqrt{5}$.

Approximate Values of sin θ, cos θ and tan θ when θ is Small: Let θ be small and measured in radians, then sin

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$\theta \approx \theta$, $\cos \approx 1$, $\tan \theta \approx \theta$. These are first degree approximations. The second degree approximations are given by

$\sin \theta \simeq \theta$, $\cos \theta \simeq 1 - \frac{1}{2}\theta^2$, $\tan \theta = \theta$.

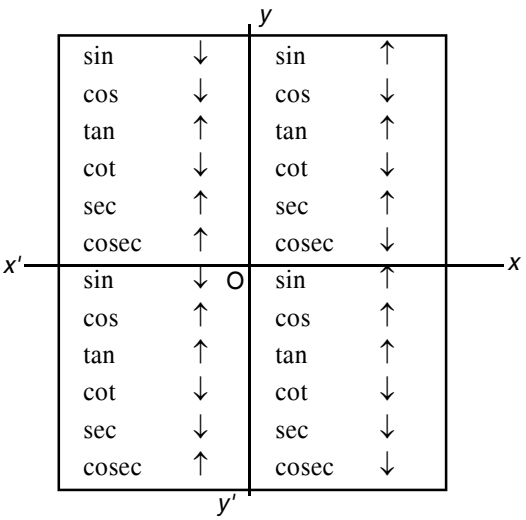
Increasing and Decreasing Behaviour of Trigonometrical Ratios: When $-\pi/2 \le \theta \le \pi/2$, $\sin \theta$ increases in Q_1 and Q_4 with angle while in Q_2, Q_3, $\sin \theta$ decreases from 1 to -1.

Thus $\theta_1 < \theta_2$

$\Rightarrow \sin \theta_1 < \sin \theta_2$ ($\theta_1, \theta_2 \in Q_1$ or Q_4)

$\Rightarrow \sin \theta_1 > \sin \theta_2$ ($\theta_1, \theta_2 \in Q_2$ or Q_3)

We can decide the behaviour of other ratios in a similar manner. If we denote ↑ for increasing and ↓ for decreasing, we have the following chart:



EXERCISE

1. The angles of a triangle are in A.P. and the radian measure of the smallest to the degree measure of the mean is $\pi : 200$. The greatest angle in radians is:
A. $(11/30)\pi$ B. $\pi/3$
C. $\pi/2$ D. None of these

2. The moon's distance from the earth is 3,50,000 kilometres and its diameter subtends an angle of 31' at the eye of the observer. The diameter of the moon is:
A. 3157 (11/27) km B. 315 (11/27) km
C. 3050 (11/27) km D. None of these

3. If $\sin \theta = -3/5$ and θ lies in the third quadrant, then the value of $\cos(\theta/2)$ is:
A. 1/5 B. $-1/\sqrt{(10)}$
C. $-1/5$ D. $1/\sqrt{(10)}$

4. If $\tan \theta = -4/3$, then $\sin \theta$ is:
A. $-4/5$ but not $4/5$ B. $-4/5$ or $4/5$
C. $4/5$ but not $-4/5$ D. None of these

5. If the angle θ is in the third quadrant and $\tan \theta = 3$, then the value of $\sin \theta$ is:
A. $1/\sqrt{(10)}$ B. $-1/\sqrt{(10)}$
C. $-3/\sqrt{(10)}$ D. $3/\sqrt{(10)}$

6. If $(\sec \alpha + \tan \alpha)(\sec \beta + \tan \beta)(\sec \gamma + \tan \gamma) = \tan \alpha \tan \beta \tan \gamma$, then $(\sec \alpha - \tan \alpha)(\sec \beta - \tan \beta)(\sec \gamma - \tan \gamma) = ?$
A. $\cot \alpha \cot \beta \cot \gamma$
B. $\tan \alpha \tan \beta \tan \gamma$
C. $\cot \alpha + \cot \beta + \cot \gamma$
D. $\tan \alpha + \tan \beta + \tan \gamma$

7. Which of the following is correct?
A. $\sin 1^\circ > \sin 1$
B. $\sin 1^\circ < \sin 1$
C. $\sin 1^\circ = \sin 1$
D. $\sin 1^\circ = (\pi/180) \sin 1$

8. Which of the following is correct?
A. $\tan 1 > \tan 2$ B. $\tan 1 = \tan 2$
C. $\tan 1 < \tan 2$ D. $\tan 1 = 1$

9. The value of $\log \tan 1^\circ + \log \tan 2^\circ + ... + \log \tan 89^\circ$ is:
A. 0 B. 1
C. ∞ D. None of these

10. The value of $\cos 105^\circ + \sin 105^\circ$ is:
A. 0 B. $\sqrt{(3/2)}$
C. $1/\sqrt{2}$ D. $(\sqrt{3}+1)/2$

11. The value of $\sin\left(67\frac{1}{2}^\circ\right)\sin\left(22\frac{1}{2}^\circ\right)$ is:
A. $-2\sqrt{2}$ B. $2\sqrt{2}$
C. $1/2\sqrt{2}$ D. $-1/2\sqrt{2}$

12. The value of $(1 + \cos\pi/8)(1 + \cos 3\pi/8)(1 + \cos 5\pi/8)(1 + \cos 7\pi/8)$ is:
A. 1/2 B. 1/4
C. 1/8 D. 1/16

13. The value of $\sin^2\frac{2\pi}{15} - \sin^2\frac{\pi}{30}$ is:
A. $(\sqrt{5}-1)/4$ B. $(\sqrt{5}-1)/8$
C. $(\sqrt{5}+1)\sqrt{3}/2$ D. $(\sqrt{5}-1)\sqrt{3}/2$

14. The value of $\sin 50^\circ - \sin 70^\circ + \sin 10^\circ$ is:
A. 0 B. 1
C. 2 D. None of these

15. The value of $(\sqrt{3}\operatorname{cosec} 20^\circ - \sec 20^\circ)$ is:
A. 2 B. $2\sqrt{3}$
C. 4 D. $\sqrt{8}/2$

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ANSWERS

1	2	3	4	5	6	7	8	9	10
A	A	B	B	C	A	B	A	A	C

11	12	13	14	15
C	C	B	A	C

EXPLANATORY ANSWERS

1. Let the angles in degrees in A.P. be taken as

$A = \theta - \phi$, $B = \theta$, $C = \theta + \phi$

$\therefore \quad A + B + C = 180° = 3\theta$

$\Rightarrow \quad B = \theta = 60°$

Now $\quad \dfrac{\pi}{200} = \dfrac{\text{A in radian}}{\text{B in degrees}}$

$= \dfrac{(60 - \phi)\,(\pi/180)}{60}$

$\Rightarrow \quad \phi = 6°$

$\therefore$ Greatest angle $C = \theta + \phi = 66°$

$= 66 \times (\pi/180)$

$= (11/30)\ \pi$ radians.

2. Let l be the diameter of moon and a its distance from the earth. If the moon subtends an angle θ at the eye of the observer, then

$$l = a\theta = 350000 \times \left(\frac{31}{60} \times \frac{\pi}{180}\right)$$

$$= \frac{3500 \times 31}{6 \times 18} \times \frac{22}{7} = 3157\ \frac{11}{27}\ \text{km.}$$

3. $\because$ θ lies in the third quadrant

$\because \quad \cos\theta$ is –ve

$\because \quad \sin\theta = -3/5$

$\Rightarrow \quad \cos\theta = -\sqrt{(1 - \sin^2\theta)} = -4/5$

Now, $\quad \cos^2 \dfrac{1}{2}\theta = \dfrac{1}{2}(1 + \cos\theta)$

$= \dfrac{1}{2}(1 - 4/5) = 1/10$

$\Rightarrow \quad \cos\dfrac{1}{2}\theta = \pm\, 1/\sqrt{(10)}$

But given that, $180° < \theta < 270°$

$\Rightarrow 90° < \theta/2 < 135°$

i.e., $\theta/2$ lies in the second quadrant

$\Rightarrow \cos\ \dfrac{1}{2}\ \theta$ is –ve

Hence $\cos\ \dfrac{1}{2}\ \theta = -1/\sqrt{10}$.

4. $\tan\theta = -4/3$

$\Rightarrow \theta$ lies in 2nd or 4th quadrant.

$\therefore \sin\theta$ is positive or negative according as θ lie in 2nd or 4th quadrant respectively, *i.e.,* $\sin\theta$ may be positive or negative.

Now $\quad \sin\theta = \tan\theta/\sqrt{(1 + \tan^2\theta)} = 4/5$

Hence $\quad \sin\theta = -4/5$ or $4/5$.

5. $\because$ θ is in the third quadrant,

$\because \sin\theta < 0$.

Thus $\quad \sin\theta = -\tan\theta/\sqrt{(1 + \tan^2\theta)}$

$= -3/\sqrt{(10)}$.

6. Multiplying both sides of the given expression by $(\sec\alpha - \tan\alpha).(\sec\beta - \tan\beta).(\sec\gamma - \tan\gamma)$, we get, 1.1.1

$= (\sec\alpha - \tan\alpha)\ .\ (\sec\beta - \tan\beta).(\sec\gamma - \tan\gamma).\tan\alpha\tan\beta\tan\gamma$

$\Rightarrow (\sec\alpha - \tan\alpha).(\sec\beta - \tan\beta).(\sec\gamma - \tan\gamma)$

$= \cot\alpha.\cot\beta.\cot\gamma$.

7. 1 radian $= (180/\pi)$ Degrees $= 57°$ (appr.)

$\therefore \sin 1° < \sin 57° \Rightarrow \sin 1° < \sin 1$.

8. 1 radian $= 57°$ (appr.)

which lie in first quadrant. $\therefore \tan 1 > 0$,

and 2 radians $= 114°$ (appr.), which lie in second quadrant $\therefore \tan 2 < 0$

Hence $\tan 1 > \tan 2$.

9. $\log\tan 1° + \log\tan 2° + \ldots + \log\tan 89°$

$= \log\left[\tan 1°.\tan 2° \ldots \tan 45° \ldots \tan 88°.\tan 89°\right]$

$= \log\left[\tan 1°.\tan 2° \ldots \tan 45° \ldots \tan(90° - 2°)\tan(90° - 1°)\right]$

$= \log\left[\tan 1°.\cot 1°.\tan 2°.\cot 2° \ldots 1\right]$

$= \log 1 = 0$

10. $\cos 105° + \sin 105°$

$= \cos(60° + 45°) + \sin(60° + 45°)$

$= \cos 60°\cos 45° - \sin 60°\sin 45°$

$+ \sin 60°\cos 45° + \cos 60°\sin 45°$

$$= \frac{1}{2}.\frac{1}{\sqrt{2}} - \frac{\sqrt{3}}{2}.\frac{1}{\sqrt{2}} + \frac{\sqrt{3}}{2}.\frac{1}{\sqrt{2}} + \frac{1}{2}.\frac{1}{\sqrt{2}}$$

$$= \frac{2}{2\sqrt{2}} = \frac{1}{\sqrt{2}}$$

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11. $\sin\left(67\frac{1^\circ}{2}\right)\sin\left(22\frac{1^\circ}{2}\right)$

$= \sin\left(45^\circ+22\frac{1^\circ}{2}\right)\sin\left(45^\circ-22\frac{1^\circ}{2}\right)$

$= \sin^2 45^\circ-\sin^2 22\frac{1^\circ}{2} = \left(\frac{1}{\sqrt{2}}\right)^2 - \frac{1-\cos 45^\circ}{2}$

$= \frac{1}{2}-\frac{1}{2}\left(1-\frac{1}{\sqrt{2}}\right) = \frac{1}{2}\left(1-1+\frac{1}{\sqrt{2}}\right) = \frac{1}{2\sqrt{2}}$

12. $\left(1+\cos\frac{\pi}{8}\right)\left(1+\cos\frac{3\pi}{8}\right)\left(1+\cos\frac{5\pi}{8}\right)\left(1+\cos\frac{7\pi}{8}\right)$

$= (1+\cos\pi/8)(1-\cos\pi/8)$

$(1+\cos 3\pi/8)(1-\cos 3\pi/8)$

$= \sin^2\pi/8.\ \sin^2 3\pi/8 = \frac{1}{4}\left(2\sin\frac{3\pi}{8}.\sin\pi/8\right)^2$

$= \frac{1}{4}\left[\cos\frac{\pi}{4}-\cos\frac{\pi}{2}\right]^2 = \frac{1}{4}\left(\frac{1}{\sqrt{2}}-0\right)^2 = \frac{1}{4}\times\frac{1}{2} = \frac{1}{8}$

13. $\sin^2\frac{2\pi}{5}-\sin^2\frac{\pi}{30} = \sin\left(\frac{2\pi}{15}+\frac{\pi}{30}\right)\sin\left(\frac{2\pi}{15}-\frac{\pi}{30}\right)$

$= \sin\frac{\pi}{6}.\sin\frac{\pi}{10} = \frac{1}{2}\times\frac{\sqrt{5}-1}{4} = \frac{1}{8}\left(\sqrt{5}-1\right)$

14. $\sin 50^\circ - \sin 70^\circ + \sin 10^\circ$

$= 2\cos 60^\circ \sin(-10)^\circ + \sin 10^\circ$

$= 2 \times \frac{1}{2} \times -\sin 10^\circ + \sin 10^\circ$

$= -\sin 10^\circ + \sin 10^\circ = 0$

15. $\sqrt{3}\,\text{cosec}\ 20^\circ - \sec 20^\circ$

$= \tan 60^\circ\ \text{cosec}\, 20^\circ - \sec 20^\circ$

$= \frac{\sin 60^\circ}{\cos 60^\circ}.\frac{1}{\sin 20^\circ} - \frac{1}{\cos 20^\circ}$

$= \frac{\sin 60^\circ\cos 20^\circ - \cos 60^\circ\sin 20^\circ}{\cos 60^\circ.\sin 20^\circ\cos 20^\circ}$

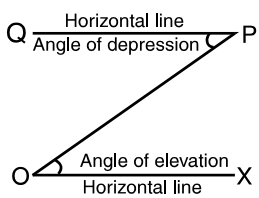
$= \frac{\sin(60^\circ-20^\circ)}{\frac{1}{2}.\frac{1}{2}(2\sin 20^\circ\cos 20^\circ)} = 4.\frac{\sin 40^\circ}{\sin 40^\circ} = 4$

Heights and Distance

Angle of Elevation and Depression: Let O and P be two points such that P is at higher level than O. Let PQ, OX be horizontal lines through P and O, respectively.

If an observer (or eye) is at O and the object is at P, then ∠XOP is called the angle of elevation of P as seen from O.

This angle is also called the angular height of P from O.



If an observer (or eye) is at P and the object is at O, then ∠QPO is called the angle of depression of O as seen from P.

EXERCISE

1. A person standing on the bank of a river observes that the angle subtended by a tree on the opposite bank is 60°, when he retires 40 metres from the bank he finds the angle to be 30°. Then the breadth of the river is:

A. 40 m B. 60 m
C. 20 m D. 30 m

2. At a point on a level plane a tower subtends an angle θ and a flag-staff *a* ft. in length at the top of the tower subtends an angle ϕ. The height of the tower is:

A. $\frac{a\sin\theta\cos\phi}{\cos(\theta+\phi)}$ B. $\frac{a\sin\theta\cos(\theta+\phi)}{\sin\phi}$

C. $\frac{a\cos(\theta+\phi)}{\sin\theta\sin\phi}$ D. None of these

3. The angle of elevation of the top of a tower standing on a horizontal plane from a point A is α. After walking a distance *a* towards the foot of the tower the angle of elevation is found to be β. The height of the tower is:

A. $\frac{a\sin\alpha\sin\beta}{\sin(\beta-\alpha)}$ B. $\frac{a\sin\alpha\sin\beta}{\sin(\alpha-\beta)}$

C. $\frac{a\sin(\beta-\alpha)}{\sin\alpha\sin\beta}$ D. $\frac{a\sin(\alpha-\beta)}{\sin\alpha\sin\beta}$

4. The angle of elevation of the top of a TV tower from the three points A, B, C in a straight line (in the horizontal plane) through the foot of the tower are α, 2α, 3α respectively. If AB = *a*, the height of the tower is:

A. *a* tan α B. *a* sin α
C. *a* sin 2α D. *a* sin 3α

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5. The height of the centre of the round balloon of radius *r,* which subtend an angle α at the eye of an observer and the elevation of whose centre from the eye is β, is given by:

A. $r \sin \alpha \sin \beta$ B. $r \operatorname{cosec} \frac{1}{2} \alpha \sin \beta$

C. $r \operatorname{cosec} \alpha \sin \beta$ D. None of these

6. ABCD is a square plot. The angle of elevation of the top of a pole standing at D from A or C is 30° and that from B is θ, then $\tan \theta$ is equal to:

A. $\sqrt{6}$ B. $1/\sqrt{6}$

C. $\sqrt{3}/\sqrt{2}$ D. $\sqrt{2}/\sqrt{3}$

7. The angle of elevation of the top of two vertical towers as seen from the middle point of the line joining the foot of the towers are 60° and 30° respectively. The ratio of the heights of the towers is:

A. 2 : 1 B. $\sqrt{3}$: 1

C. 3 : 2 D. 3 : 1

8. ABC is a triangular park with AB = AC = 100 metres. A clock tower is situated at the mid-point of BC. The angles of elevation of the top of the tower of A and B are $\cot^{-1}$ (3.2) and $\operatorname{cosec}^{-1}$ (2.6) respectively. The height of the tower in metres is:

A. 25/2 B. 25

C. 50 D. None of these

9. The angles of elevation of the top of a vertical tower from two points, distant a and b ($a > b$) from the base and in the same straight line with it are complementary. Then the height of the tower is:

A. $\sqrt{(ab)}$ B. $\sqrt{(a^2 + b^2)}$

C. $\sqrt{(a^2 - b^2)}$ D. $\sqrt{a(a - b)}$

10. From the top of a h metre high cliff the angles of depression of the top and the bottom of a tower are observed to be 30° and 60° respectively. The height of the tower is:

A. $h\sqrt{3}$ B. $2h\sqrt{3}$

C. $h/3$ D. $2h/3$

11. A vertical pole is 75m high. Find the angle subtended by the pole a point 75 m away from its base.

A. 30° B. 45°

C. 60° D. 90°

12. A person standing on the bank of river finds that the angle of elevation of the top of a tower on opposite side bank is 45°. Which of the following statement is correct?

A. Breadth of the river is half of the height of the tower

B. Breadth of the river and the height of the tower are equal

C. Breadth of the river is twice the height of the tower

D. None of these

13. The angles of depression of two ships from the top of a light house are 45° and 30° towards east. If the ships are 200 m apart, find the height of the light house.

A. 100 m B. 173 m

C. 200 m D. 273 m

14. A man 2 m high, walks at a uniform speed of 6 m/min away from a lamp post, 5 m high. Find the rate at which the length of his shadow increases.

A. 4 m/min B. 8 m/min

C. 9 m/min D. 14 m/min

15. Two ships leave a port at the same instant. One sails at 30 km/hr in the direction N 32°E while the other sails at 20 km/hr in the direction S 58° E. After two hours the ships are distant from each other by:

A. $15\sqrt{6}$ km B. 36.5 km

C. $20\sqrt{13}$ km D. 100 km

ANSWERS

1	2	3	4	5	6	7	8	9	10
C	B	A	C	B	B	D	B	A	D
11	**12**	**13**	**14**	**15**					
B	B	D	A	C					

EXPLANATORY ANSWERS

1. Let A be the position of a person on the bank of a river and OP the tree on the opposite bank and $\angle OAP = 60°$. When the person retires to the position B, s.t.

AB = 40 m then $\angle$ OBP = 30°

Let OA = x m and OP = h m

In Δ OAP, OP = OA tan 60° = $x\sqrt{3}$

and in Δ OBP, OP = OB tan 30° = $(x + 40)/\sqrt{3}$

$\therefore$ $(x + 40)/\sqrt{3} = x\sqrt{3} \Rightarrow x = 20$ m

2. Let OP be the tower of height h (say) and PQ the flag-staff of height a, such that

$\angle OAP = \theta$ and $\angle PAQ = \phi$

In ΔOAP and ΔOAQ

$OA = OP \cot \theta = h \cot \theta$

and $OA = OQ \cot (\theta + \phi)$

$= (h + a) \cot (\theta + \phi)$

$\therefore$ $h \cot \theta = (h + a) \cot (\theta + \phi)$

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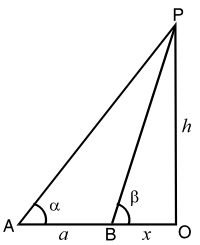
$\Rightarrow h = \dfrac{a\cot(\theta+\phi)}{\cot\theta - \cot(\theta+\phi)} = \dfrac{a\sin\theta\cos(\theta+\phi)}{\sin\phi}$.

3. Let OP be the tower of height h (say) and A and B be the two positions on the horizontal line through O, such that

$\angle OAP = \alpha$, $\angle OBP = \beta$ and $OB = x$



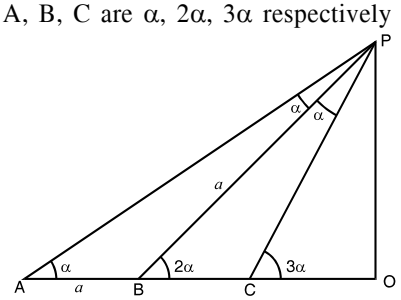
In ΔOBP, $OB = x = h \cot \beta$, and

in ΔOAP, $OA = a + x = h \cot \alpha$

$\therefore\ a = h(\cot\alpha - \cot\beta)$

$\Rightarrow h = a \sin\alpha \sin\beta/\sin(\beta - \alpha)$

4. OP is vertical tower. The elevations of the top of P from A, B, C are α, 2α, 3α respectively

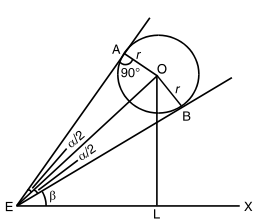


$\angle OAP = \angle APB = \alpha$

$\therefore$ $AB = PB = a$

In ΔOBP, $OP = PB \sin 2\alpha = a \sin 2\alpha$

5. Let O be the centre of the balloon of radius r which subtend an angle α at the eye of an observer at E.



If EA and EB are the tangents to the balloon,

then $\angle OEA = \angle OEB = \dfrac{\alpha}{2}$

In ΔOAE, $\sin\dfrac{1}{2}\alpha = OA/OE$ $\therefore$ $OE = r$ cosec $\dfrac{1}{2}\alpha$

In ΔOEL, height of the centre of the balloon

$= h = OE \sin\beta = r$ cosec $\dfrac{1}{2}\alpha \sin\beta$.

6. Let a be the length of a side of square plot ABCD and h, the height of the pole standing at D. Since elevations of P from A or C is 30° and that from B is θ,

$\therefore$ In ΔPCD, $\tan 30° = h/a$

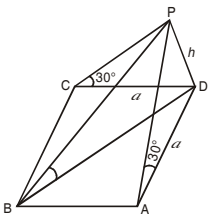
i.e., $h/a = 1/\sqrt{3}$

And in ΔPBD,

$\tan\theta = PD/BD$

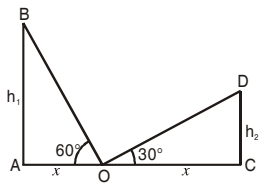
$= h/(a\sqrt{2})$

$= 1/\sqrt{6}$



$\therefore$ $BD = \sqrt{(AB^2 + AD)^2} = a\sqrt{2}$.

7. Let AB and CD be two towers of heights h_1 and h_2 respectively and O the mid-point of the line joining the foots A and C of the towers.



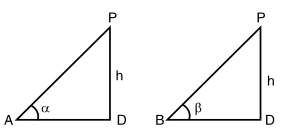
Let $OA = OC = x$

Then $h_1 = x \tan 60° = x\sqrt{3}$

and $h_2 = x \tan 30° = x/\sqrt{3}$

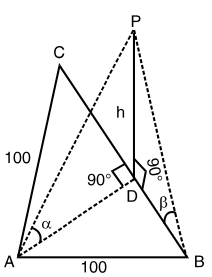
$\therefore\ \dfrac{h_1}{h_2} = \dfrac{3}{1}$, Hence, $h_1 : h_2 = 3 : 1$.

8. Given $\alpha = \cot^{-1}(3.2)$, $\beta = \text{cosec}^{-1}(2.6)$



In ΔPAD, $AD = h \cot\alpha$,

In ΔPBD, $BD = h \cot\beta$



In ΔABD, $AB^2 = AD^2 + BD^2$

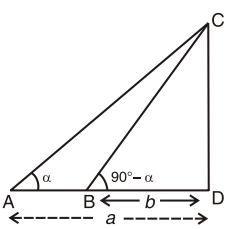
$= h^2(\cot^2\alpha + \cot^2\beta)$

$\Rightarrow 100^2 = h^2\{\cot^2\alpha + (\text{cosec}^2\beta - 1)\}$

$\Rightarrow 100^2 = h^2[(3.2)^2 + (2.6)^2 - 1] = 16h^2$

$\Rightarrow$ $h = 25$ m.

9. Let $CD = h$ unit be the height of the tower and A and B be the two points on the ground, such that $DA = a$; $DB = b$; $\angle DAC = \alpha$ and $\angle DBC = 90° - \alpha$



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From right triangle ADC,

$$CD = h = a\tan\alpha \quad ...(i)$$

From right triangle BDC,

$$CD = h = b\tan(90° - \alpha)$$
$$= b\cot\alpha \quad ...(ii)$$

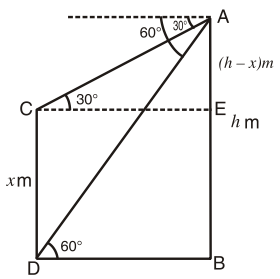
Multiplying equations *(i)* and *(ii)*, we get

$$h^2 = a\tan\alpha \cdot b\cot\alpha$$

Hence, $h = \sqrt{ab}$

10. Let AB = h m be the height of cliff and CD = x m be the height of the tower and also $\angle ADB = 60°$ and $\angle ACE = 30°$.

Now, from the figure, AE = $(h - x)$m



From right triangle ABD,

$$BD = h\cot 60° = \frac{h}{\sqrt{3}}\text{ m}$$

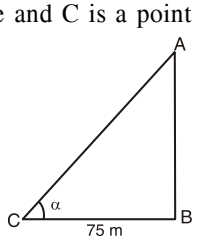
From right triangle CEA,

$$(h - x) = EC\tan 30° = BD\tan 30°$$

$$\Rightarrow \quad h - x = \frac{h}{\sqrt{3}}\cdot\frac{1}{\sqrt{3}} \quad \therefore x = h - \frac{h}{3} = \frac{2h}{3}m$$

11. Let AB = 75m be the height of pole and C is a point on the ground such that BC = 75m

Now, from right triangle ABC,

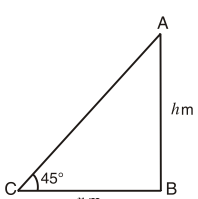


$$\tan\alpha = \frac{AB}{BC} = \frac{75}{75}$$

$$\Rightarrow \quad \tan\alpha = 1$$

$$\therefore \quad \alpha = 45°$$

12. Let AB = h m be the height of the tower; BC = x m be the breadth of the river and also $\angle ACB = 45°$

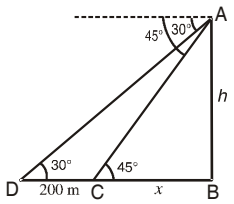


Now from right triangle ABC

$$\tan 45° = \frac{h}{x} \Rightarrow 1 = \frac{h}{x} \quad \therefore x = h$$

Hence, breadth of the river = height of the tower

13. Let AB = hm be the height of the tower and two ships are situated at D and C respectively; such that, CD = 200 m; $\angle$ ADC = 30°; $\angle$ ACB = 45° and BC = xm (say)



Now from right triangle ABC,

$$\tan 45° = \frac{h}{x} \Rightarrow 1 = \frac{h}{x} \quad \therefore x = h$$

Again from right triangle ABD,

$$\tan 30° = \frac{h}{200 + x}$$

$$\Rightarrow \quad \frac{1}{\sqrt{3}} = \frac{h}{200 + h} \quad (\because x = h)$$

$$\Rightarrow \quad \sqrt{3}h - h = 200$$

$$\Rightarrow \quad h(1.732 - 1) = 200$$

$$\therefore \quad h = \frac{200}{0.732} = 273.2\text{ m} \simeq 273\text{ m}$$

14. Let AB = 5m and CD = 2m be the heights of a lamp post and the men respectively. At any time t BD = x m and shadow of man ED = y m.

Then, $\frac{dx}{dt}$ = 6m/min

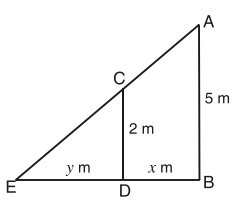
Now, right triangles ABE and CDE are similar; then

$$\frac{AB}{CD} = \frac{BE}{DE} \Rightarrow \frac{5}{2} = \frac{x + y}{y}$$

$$\Rightarrow \quad 5y - 2y = 2x$$

$$\Rightarrow \quad 3y = 2x$$

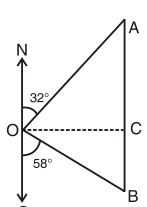
$$\Rightarrow 3.\frac{dy}{dt} = 2.\frac{dx}{dt}$$



$$\Rightarrow 3.\frac{dy}{dt} = 2 \times 6 \quad \therefore \frac{dy}{dt} = 4$$

Hence, length of his shadow increases at the rate of 4 m/min.

15. Let two ships started from point O at the speed of 30 km/hr 0 and 20 km/hr respectively, after two hours they reach at points A and B.



Now, $\angle$ NOA = 32° and $\angle$ SOB = 58°,

Then, $\angle$ AOB = 180° – (32° + 58°) = 90°

Since Δ AOB is a right triangle in which OA = 2 × 30 = 60 km and OB = 2 × 20 = 40 km

Since, AB = $\sqrt{OA^2 + OB^2} = \sqrt{(60)^2 + (40)^2}$

$$= \sqrt{5200} = 20\sqrt{13}\text{ km}$$

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CHAPTER 13

Data Handling

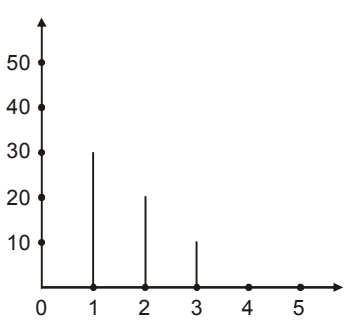
Histogram; Frequency Polygon; Bar Diagram & Pie-Chart

Graphical Representation of Statistical Data

One of the most convincing and appearing ways in which statistical result may be presented is through diagrams and graphs. The impressions created by diagrams last much longer than those created by the figures presented in a tabular form.

Rather than present data numerically in the form of a table it can sometimes be better to illustrate the information through the use of graphs, charts, diagrams and so on.

The frequency distribution of a discrete value is best represented by a bar diagram. The height of the bars is proportional to the frequency of each variate-value. The bars must be kept distinct to show that the variate-values are distinct.



A simple bar chart is used to illustrate a frequency distribution. The lengths of the bars are proportional to the frequency and the bars are of equal width.

Some Important Types of Diagrams and Graphs

The different types of Diagrams and Graphs

(1) Bar diagram

(2) Histogram

(3) Frequency circle

(4) Cumulative frequency curve of the ogive

(5) Pie diagram.

Bar Diagram

Bar diagram is the easiest and most adaptable general purpose chart. In this, bars or rectangles of uniform width are drawn with equal spaces in between on the axis. Along the *y*-axis is shown, the scale of the height of the rectangles.

Thickness of bars is not taken into account, they should be so constructed that they look attractive and beautiful. This can be done by colouring them or by preparing designs in them.

However, the colour or designs of all bars representing one type of data should be identical. The bars may be vertical or horizontal. Some of the main bar diagrams are:

(*i*) Simple Bar-Diagram

(*ii*) Sub-divided Bar-Diagram

(*iii*) Multiple Bar-Diagram

The following Examples of Illustrate :

Example: The following table gives the population of India (in millions). Draw a bar diagram of the data:

Population (in million) of India 1931-1971

Year	Population (*in millions*)
1931	275.5
1941	312.1
1951	356.9
1961	439.9
1971	546.9

Solution: The above data is represented by a simple bar diagram as follows :

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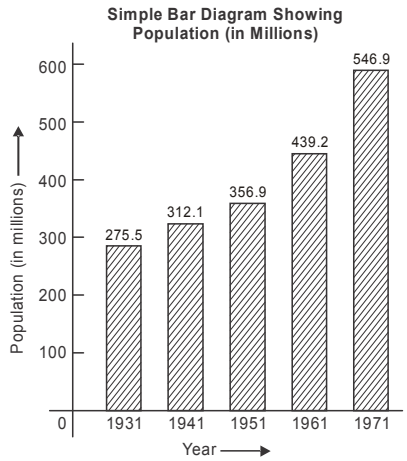


Here years are denoted on the x-axis and population (in millions) on the y-axis. The length of each bar corresponds to the number representing population on the y-axis.

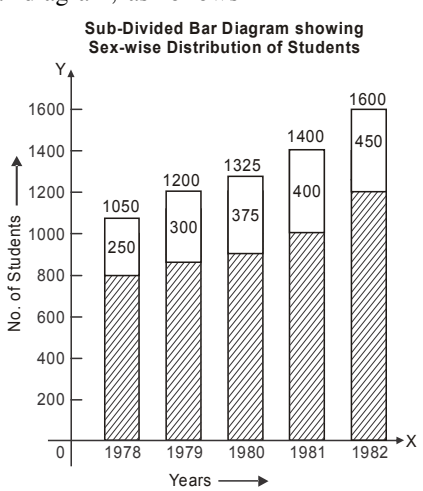
Sub-Divided or Component Bar Diagram

The sub-divided bar diagram is used where the total magnitude of the given variable is to be divided into various parts or sub-classes. The bars are drawn proportional in length to the total and divided in the ratios of their components. Different colours, shades, designs, etc. are used to distinguish the various components.

Example: Represent the following data of sex-wise distribution of students in a school by a bar diagram.

Year	No. of Students		Total
	Male	*Female*	
1978	800	250	1050
1979	900	300	1200
1980	950	375	1325
1981	1000	400	1400
1982	1150	450	1600

Solution: The above data are represented by a sub-divided bar diagram, as follows.



In a multiple bar diagram two or more sets of inter-related data are presented. The technique of drawing such a diagram is basically the same as that of simple bar diagram.

Histograms

The histogram is most popularly used for graphical presentation of a frequency distribution. A histogram is a graph that represents the class frequencies in a frequency distribution by vertical adjacent rectangles. After choosing a convenient scale on the axes, mark off the class intervals along x-axis and the frequencies of the respective class intervals along y-axis. Then construct rectangles with each class intervals as breadth and the respective frequency of the class interval as height. The set of the all adjacent rectangles so constructed form a histogram.

Note : A histogram is a development of the bar chart but remember when drawing a histogram it is the Area of each bar which is proportional to the frequency and there are no gaps between the bars because the classes are usually arranged so that there are no gaps.

The following Examples of Illustrates:

Example: The time taken, in seconds, to solve a problem by each of 25 pupils is as follows: 16, 20, 26, 27, 28, 30, 33, 37, 38, 40, 42, 42, 43, 46, 46, 48, 49, 50, 53, 58, 59, 60, 64, 52, 20.

(a) Construct a frequency distribution for these data, using a class interval of 10 seconds.

(b) Draw a histogram to represent the frequency distribution.

Solution:

(a) Lowest observation = 10

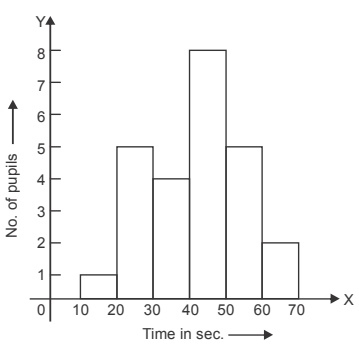
Highest observation = 64

Range = 64 – 10 = 54

We can have six classes, each of width 10.

Frequency Distribution Table

Time (in seconds)	Tally marks	Number of pupils
10 – 20	I	1
20 – 30	𝍸	5
30 – 40	IIII	4
40 – 50	𝍸 III	8
50 – 60	𝍸	5
60 – 70	II	2
Total		25



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Frequency Polygon

A frequency polygon is a graph of frequency distribution. The steps constructing a frequency polygonal are:

1. Draw a suitable histogram keeping in view all the basic principles.
2. Get the mid-points of the upper horizontal side of each rectangle.
3. Join these mid-points of the adjacent rectangles of the histogram by straight lines taken in order, they form a polygon called frequency polygon.
4. End of frequency polygon preferably extended to the base line.

In a frequency polygon the variables or individuals of each class are assumed to be concentrated at the class-intervals.

Note: If only frequency polygon is to be drawn, first represent the class-marks (x_i) on the x-axis and corresponding frequencies (f_i) on y-axis. Plot all the points (x_i, f_i). Then join these points by line segments. The figure so obtained is known as the frequency polygon. The polygon should be brought down at the ends to the x-axis at each and of the drawn.

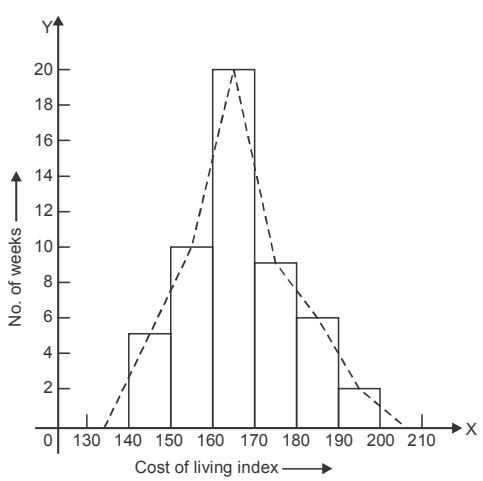
The following Examples of Illustrate:

Example: In a city the following weekly observations were made in a study on cost of Living Index for the year 1970–71.

Cost of Living Index	No. of weeks
140 – 150	5
150 – 160	10
160 – 170	20
170 – 180	9
180 – 190	6
190 – 200	2

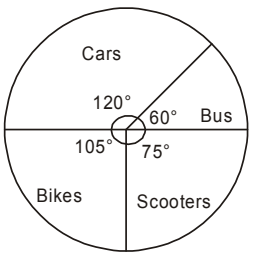
Draw a histogram and frequency polygon on the same scale.

Solution:



Pie Diagram

Pie-diagrams are used to represent a relative frequency distribution. A pie diagram consists of a circle divided into as many sectors as there are classes in a frequency distribution. The area of each sector is proportional to the relative frequency of the class.

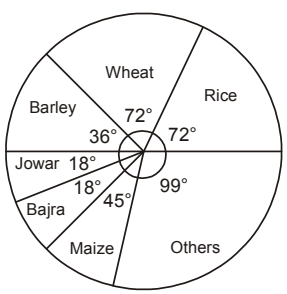


Now we make angles at the centre proportional to the relative frequencies. And in order to get the angles of the disired sectors, we divide 360° in the proportion of the various relative frequencies, *i.e.*,

$$\text{Central angle} = \left[\frac{\text{Frequency} \times 360^\circ}{\text{Total frequency}}\right]$$

Example : The pie-chart provided below gives the distribution of land (in a village) under various food crops. Study the pie-chart carefully and answer the questions that follow.

Distribution of Areas (in Acre)
Under various Food Crops



1. Which combination of three crops contribute to 50% of the total area under the food crops?
(*a*) Wheat, Barley and Jowar
(*b*) Rice, Wheat and Jowar
(*c*) Rice, Wheat and Barley
(*d*) Bajra, Maize and Rice

2. If the total area under jowar was 1.5 million acres, then what was the area (in million acres) under rice?
(*a*) 6 (*b*) 7.5
(*c*) 9 (*d*) 4.5

3. If the production of wheat is 6 times that of barley, then what is the ratio between the yield per acre of wheat and barley?
(*a*) 3 : 2 (*b*) 3 : 1
(*c*) 12 : 1 (*d*) 2 : 3

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Solution:

1 (*c*): The total of the central angles corresponding to the three crops which cover 50% of the total area, should be 180°. Now, the total of the central angles for the given combinations are:

(*i*) Wheat, Barley and Jowar
= (72° + 36° + 18°)
= 126°

(*ii*) Rice, Wheat and Jowar
= (72° + 72° + 18°)
= 162°

(*iii*) Rice, Wheat and Barley
= (72° + 72° + 36°)
= 180°

(*iv*) Bajra, Maize and Rice
= (18° + 45° + 72°)
= 135°

Clearly, (*iii*) is the required combination.

2 (*a*): The area under any of the food crops is proportional to the central angle corres-ponding to that crop.
Let, the area under rice production be x million acres.

Then, 18 : 72 = 1.5 : x

$\Rightarrow x = \left(\frac{72 \times 1.5}{18}\right) = 6.$

Thus, the area under rice production = 6 million acress

3 (*b*): Let, the total production of barley be T tonnes and let Z acres of land be put under barley production. Then, the total production of wheat = (6T) tonnes. Also, area under wheat production = (2Z) areas.

$$\left[\because \frac{\text{Area under Wheat production}}{\text{Area under Barley production}} = \frac{72°}{36°} = 2 \right.$$
$$\left. \text{and therefore, Area under wheat} = 2 \times \text{Area under barley} = (2Z) \text{ acres} \right]$$

Now, yield per acre for wheat

$= \left(\frac{6T}{2Z}\right)$ tonnes/acre $= \left(\frac{3T}{Z}\right)$ tonnes/acre

and yield per acre for barley

$= \left(\frac{T}{Z}\right)$ tonnes/acre.

$\therefore$ Required Ratio $= \left(\frac{3T/Z}{T/Z}\right) = 3:1.$

EXERCISE

1. Which one of the following is not the graphical representation of statistical data?
A. Bar graph
B. Histogram
C. Frequency polygon
D. Cumulative frequency distribution

2. In a frequency distribution, ogives are graphical representation of:
A. Frequency
B. Relative frequency
C. Cumulative frequency
D. Raw data

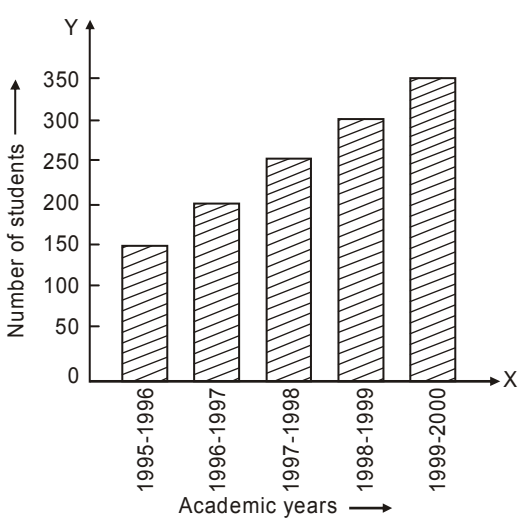
3. A frequency polygon is constructed by plotting frequency of the class interval and the:
A. upper limit of the class
B. lower limit of the class
C. mid value of the class
D. any values of the class

4. In a histogram the area of each rectangle is proportional to:
A. the class mark of the corresponding class interval
B. the class size of the corresponding class interval
C. frequency of the corresponding class interval
D. cumulative frequency of the corresponding class interval

5. In a histogram, each class rectangle is constructed with base as:
A. frequency
B. class-intervals
C. range
D. size of the class

6. Read the bar graph shown in figure and answer the following question:

In which year is the increase of students maximum?



A. 1996-1997
B. 1997-1998
C. 1999-2000
D. None of these

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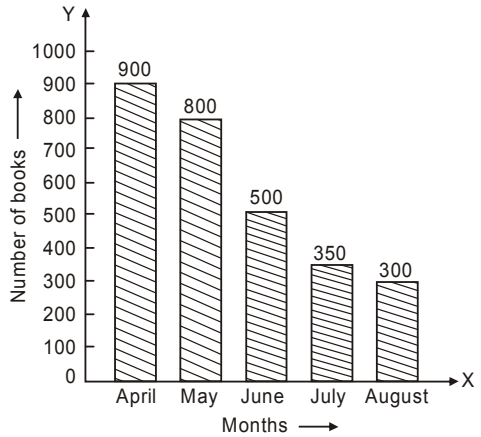
Directions (Qs. 7 to 9) : *Read the following bar graph shown in figure and answer the following questions:*

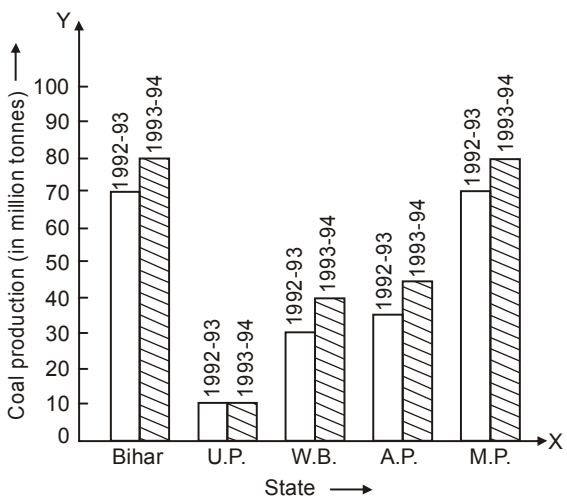


7. In which month was the sale of the books maximum?
A. April B. May
C. June D. August

8. In which month was the sale of the books minimum?
A. April B. May
C. July D. August

9. What is the total sale during these five months?
A. 3800 copies B. 2850 copies
C. 2800 copies D. 2950 copies

Directions (Qs. 10 to 12) : *Read the following bar graph given in figure and answer the following questions:*

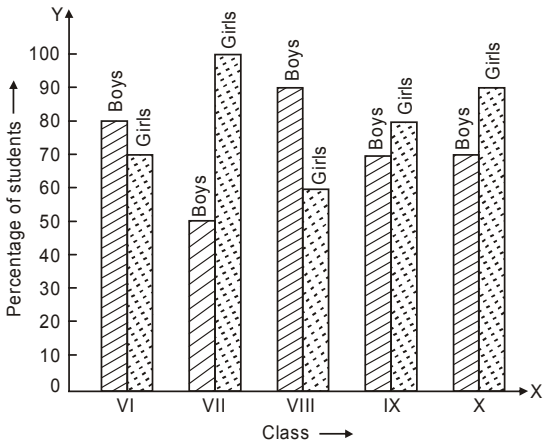


10. Which two states have same production in 1993-94?
A. M.P. and Bihar
B. M.P. and U.P.
C. U.P. and Bihar
D. W.B. and U.P.

11. Which state has same production in both the years?
A. M.P. B. Bihar
C. U.P. D. W.B.

12. Which state has minimum production?
A. M.P. B. A.P.
C. W.B D. U.P.

Directions (Qs. 13 to 15) : *The following bar graph shows the results of an annual examination in a secondary school. Read the bar graph and choose the correct alternative in each of the following.*

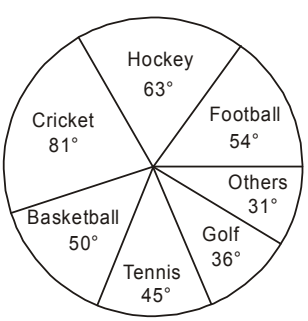


13. The pair of classes in which the results of boys and girls are inversely proportional are:
A. VI, VIII B. VI, IX
C. VIII, IX D. VIII, X

14. The class having the lowest failure rate of girls is:
A. VII B. X
C. IX D. VIII

15. The class having the lowest pass rate of boys is:
A. VI B. VII
C. VIII D. IX

Directions (Qs. 16 to 20) : *The circle-graph given here shows the spendings of a country on various sports during a particular year. Study the graph carefully and answer the questions given below it.*



16. What per cent of the total spendings is spent on Tennis?
A. $12\frac{1}{2}\%$ B. $22\frac{1}{2}\%$
C. 25% D. 45%

17. How much per cent more is spent on Hockey than that on Golf?
A. 27% B. 35%
C. 37.5% D. 75%

18. How much per cent less is spent on Football than that on Cricket?

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A. $22\frac{2}{9}\%$ B. 27%

C. $33\frac{1}{3}\%$ D. $37\frac{1}{2}\%$

19. If the total amount spent on sports during the year was ₹ 2 crores, the amount spent on Cricket and Hockey together was:

A. ₹ 8,00,000 B. ₹ 80,00,000

C. ₹ 1,20,00,000 D. ₹ 1,60,00,000

20. If the total amount spent on sports during the years be ₹ 1,80,00,000, the amount spent on Basketball exceeds that on Tennis by:

A. ₹ 2,50,000 B. ₹ 3,60,000

C. ₹ 3,75,000 D. ₹ 4,10,000

ANSWERS

1	2	3	4	5	6	7	8	9	10
D	C	C	C	B	D	A	D	B	A
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
C	D	B	A	B	A	D	C	B	A

EXPLANATORY ANSWERS

6. The increase in the number of students is uniform as the increase in the heights of bars is uniform. Hence, in this case the increase is not maximum in any of the year.

7. The sale of the books was maximum in the month of April as the height of the rectangle corresponding to April month is maximum.

8. The sale of the books was minimum in the month of August as the height of the corresponding rectangle is minimum.

9. Total sale of the books during 5 months.

(900 + 800 + 500 + 350 + 300) = 2850 copies.

10. M.P. and Bihar have same production in 1993-1994.

11. U.P. has the same production in both the years.

12. U.P.

16. Percentage of money spent on Tennis

$$= \left(\frac{45}{360}\times 100\right)\% = 12\frac{1}{2}\%$$

17. Let the total spendings on sports be ₹ x. Then,

Amount spent on Golf = ₹ $\left(\frac{36}{360}\times x\right) = ₹\frac{x}{10}$

Amount spent on Hockey

= ₹ $\left(\frac{63}{360}\times x\right) = ₹\frac{7}{40}x.$

Difference = ₹ $\left(\frac{7}{40}x - \frac{x}{10}\right) = ₹\frac{3x}{40}$

$\therefore$ Required Percentage

$$= \left[\left(\frac{3x/40}{x/10}\right)\times 100\right]\% = 75\%$$

18. Let the total spendings on sports be ₹ x. Then,

Amount spent on Cricket

= ₹ $\left(\frac{81}{360}\times x\right) = ₹\left(\frac{9}{40}x\right)$

Amount spent on Football

= ₹ $\left(\frac{54}{360}\times x\right) = ₹\left(\frac{3}{20}x\right)$

Difference = ₹ $\left(\frac{9}{40}x - \frac{3}{20}x\right) = ₹\frac{3}{40}x$

$\therefore$ Required Percentage

$$= \left[\left(\frac{3x/40}{9x/40}\right)\times 100\right]\% = 33\frac{1}{3}\%$$

19. Amount spent on Cricket and Hockey together

= ₹ $\left[\frac{(81+63)}{360}\times 2\right]$ crores

= ₹ 0.8 crores = ₹ 8000000.

20. Amount spent on Basketball exceeds that on Tennis by :

= ₹ $\left[\frac{(50-45)}{360}\times 18000000\right]$ = ₹ 250000.

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GENERAL KNOWLEDGE

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INDIAN HISTORY

ANCIENT INDIA

INDUS VALLEY CIVILISATION
(2500-1750 BC)

- The earliest excavations in the Indus valley were done at Harappa in the West Punjab and Mohenjodaro in Sindh. Both places are now in Pakistan.

Important Sites

- The most important sites are Kot Diji in Sindh, Kalibangan in Rajasthan, Ropar in the Punjab, Banawali in Haryana, Lothal, Surkotada and Dhaulavira, all the three in Gujarat.
- Mohenjodaro is the largest of all the Indus cities and it is estimated to have spread over an area of 200 hectares.

Indus Valley Civilisation : An Objective Study

Major Sites	*Excavators*	*Year*	*River*	*Location*	*Important Findings*
1. Harappa	D.R. Sahni	1921	Ravi	West Punjab (Pakistan)	Granaries, Virgin Goddess, Cemetery, Stone symbol of Lingam and Yoni
2. Mohenjodaro	R.D. Banerjee	1922	Indus	Sindh (Pakistan)	Great Bath, Great Granary, Assembly Hall, Proto-Shiva, Brick Kilns, Mesopotamian seals
3. Chanhudaro	N.G. Mazumdar	1931	Indus	Sindh (Pakistan)	Bronze toy cart, Ink-pot, Lipstick, City without a citadel
4. Kalibangan	B.B. Lal & B.K. Thapar	1953	Ghaggar	Ganganagar (Rajasthan)	Decorated bricks, ploughed field surface, Firealtars
5. Lothal	S.R. Rao	1957	Bhogwa	Ahmedabad (Gujarat)	Dockyard, Rice husk, Fire altars, Double burial
6. Banawali	R.S. Bist	1973	Ghaggar	Hissar (Haryana)	Toy plough, Gridiron pattern of Town planning.
7. Dholavira	R.S. Bist	1990	Luni	Kutchh (Gujarat)	A Large well & a bath, A stadium
8. Surkotada	J. Joshi	1964	—	Gujarat	Bones of Horse, Pot burials

Salient Features of the Harappan Culture

- The Harappan Civilization was primarily Urban.
- Mohenjodaro and Harappa were the planned cities.
- The large-scale use of burnt bricks in almost all kinds of constructions are the important characteristics of the Harappan culture.
- Another remarkable feature was the underground drainage system connecting all houses to the street drains which were covered by stone slabs or bricks.
- The most important public place of Mohenjodaro is the Great Bath measuring 39 feet length, 23 feet breadth and 8 feet depth.
- Agriculture was the most important occupation. In the fertile soils, farmers cultivated two crops a year. They were the first who had grown paddy.
- Wheat and barley were the main crops grown besides sesame, mustard and cotton.
- Animals like sheep, goats and buffalo were domesticated. The use of horse is not yet firmly established.
- Bronze and copper vessels are the outstanding examples of the Harappan metal craft.
- A large number of seals numbering more than 2000 have been discovered.

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Social Life

- Jewelleries such as bangles, bracelets, fillets, girdles, anklets, ear-rings and finger rings were worn by women. These ornaments were made of gold, silver, copper, bronze and semi precious stones.
- Fishing was a regular occupation while hunting and bull fighting were other pastimes.
- Manufacture of terracotta (burnt clay) was a major industry of the people.
- Figures of animals such as sacred bull and dove were discovered. The figures of Mother Goddesses were used for religious purposes.
- Most of the inscriptions were engraved on seals. It is interesting to note that the Indus script has not yet been deciphered.
- The Pipal tree was used as a religious symbol.
- The origin of the '*Swastika*' symbol can be traced to the Harrapan Civilization.
- The chief male deity was Pasupati, (proto-Siva) represented in seals as sitting in a yogic posture with three faces and two horns.

THE VEDIC PERIOD

RIG VEDIC AGE (1500 - 1000 B.C.)

- The Early Vedic period is known from the *Rig Veda*.
- The *Rig Veda* refers to Saptasindhu or the land of seven rivers. This includes the five rivers of the Punjab, namely, Jhelum, Chenab, Ravi, Beas and Sutlej along with the Indus and Saraswati.
- Historians view that the Aryans came from Central Asia. They entered India through the Khyber pass between 2000 B.C. and 1500 B.C. They first settled in seven places in the Punjab region which they called Sapta Sindhu. Slowly, they moved towards the Gangetic Valley.
- The Aryan Civilisation was a rural civilisation.

Vedic Literature

- The word 'Veda' is derived from the root 'vid', which means to know and signifies 'superior knowledge'.
- The Vedic literature consists of the four Vedas – Rig, Yajur, Sama and Atharva.
- The *Rig Veda* is the earliest of the four Vedas divided into 10 mandalas and it consists of 1028 hymns. The hymns were sung by *Hotri* in praise of various gods.
- The *Yajur Veda* consists of various details of rules to be observed at the time of sacrifice. Its hymns were recited by *Adharvayus*.
- The *Sama Veda* is set to tune for the purpose of chanting during sacrifice. It is called the book of chants and the origins of Indian music are traced in it. Its hymns were recited by *Udgatri*.
- The *Atharva Veda* contains details of rituals.
- Besides the Vedas, there are other sacred works like the Brahmanas, the Aranyakas, the Upanishads, and the epics Ramayana and Mahabharata.

Political Organisation

- During this period, the kingdom was tribal in character. Each tribe formed a separate kingdom.
- The basic unit of political organisation was *kula* or family.
- The highest political unit was called *jana* or tribe.
- There were several tribal kingdoms during the Rig Vedic period such as Bharatas, Matsyas, Yadus and Purus. The head of the kingdom was called as *rajan* or king.
- There were two popular bodies called the *Sabha* and *Samiti*. The former seems to have been a council of elders and the latter, a general assembly of the entire people.

Social Life

- Family was the basis of the society.
- The head of the family was known as *grihapathi*.

Economic Condition

- The Rig Vedic Aryans were pastoral people and their main occupation was cattle rearing. Their wealth was estimated in terms of their cattle.
- Carpentry was another important profession.

RELIGION

- The important Rig Vedic gods were Prithvi (Earth), Agni (Fire), Vayu (Wind), Varuna (Rain) and Indra (Thunder).
- Indra was the most popular among them during the early Vedic period.
- There were also female gods like Aditi and Ushas. There were no temples and no idol worship during the early Vedic period.

Rigvedic Rivers

River	Name in Rigveda
Indus	Sindhu
Jhelum	Vitasta
Chenab	Asikni
Ravi	Parushini
Beas	Vipasa
Sutlej	Sutudri
Gomati	Gomal
Saraswati	Sarasvati
Ghaggar	Prishadavati

LATER VEDIC PERIOD (1000–600 B.C.)

- This age is also called as the Epic Age because the two great epics the Ramayana and Mahabharata were written during this period.

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- The Sama, Yajur, Atharva Vedas, Brahmanas, Aranyakas, Upanishads and the two epics are the sources of information for this period.

Political Organisation

- Larger kingdoms were formed during the later Vedic period.
- The king performed various rituals and sacrifices to strengthen his position. They include Rajasuya (consecration ceremony), Asvamedha (horse sacrifice) and Vajpeya (chariot race).
- Kingship became hereditary.
- Kings assumed titles like Ekrat, Samrat and Sarvabhauma.

Economic Condition

- Iron was used extensively in this period and this enabled the people to clear forests and to bring more land under cultivation. Agriculture became the chief occupation.
- Taxes like Bali, Sulk and Bhaga were collected from the people.
- Wealth was calculated in terms of cows.

Social Life

- The four divisions of society (Brahmins, Kshatriyas, Vaisyas and Sudras) or the Varna system was thoroughly established during the Later Vedic period.
- The Ashrama system was formed to attain 4 purusharthas. They were *Dharma*, *Artha*, *Kama* and *Moksha*.

Religion

- Gods of the Early Vedic period like Indra and Agni lost their importance. Prajapathi (the creator), Vishnu (the protector) and Rudra (the destroyer) became prominent during the Later Vedic period.

JAINISM AND BUDDHISM

JAINISM

- Jainism originated in the 6th century B.C. It rejected Vedic religion and avoided its rituals.
- Founded by Rishabha Deva. Rishabha Deva was succeeded by 23 Thirthankaras (prophets). Mahavira was the 24th Thirthankara.

Vardhamana Mahavira (540-468 B.C.)

- Vardhamana was born in a village called Kundagrama near Vaishali in Bihar.
- His father was *Siddhartha*. He was the head of a famous Kshatriya clan.
- His mother was *Trisala*. She was a princess of the Lichchhavi clan. She was the sister of the ruler of Vaishali.
- Vardhamana was married to *Yasoda,* a princess. They had a daughter.
- At the age of 30, he left his home and family. He became an ascetic (monk). He wandered from place-to-place in search of truth for 12 years.
- In the 13th year of his penance, he attained the highest spiritual knowledge called Kevalya or Jnana. Thereafter, he was called Mahavira and Jina. His followers were called Jains and his religion Jainism.
- He died at the age of 72 in 468 B.C. at a place called Pavapuri near modern Rajgir in Bihar.

Teachings of Jainism

- The three principles of Jainism, also known as Triratnas (three gems), are:
  1. right faith.
  2. right knowledge.
  3. right conduct.
- Mahavira preached his disciples to follow the five principles. They are:
  1. Ahimsa—not to injure any living beings
  2. Satya—to speak the truth
  3. Asteya—not to steal
  4. Tyag—not to own property
  5. Brahmacharia—to lead a virtuous life.

Spread of Jainism

- Mahavira preached his religion in Prakrit language which was the language of the masses.
- Chandragupta Maurya, Kharavela of Kalinga and the royal dynasties of south India such as the Gangas, the Kadambas, the Chalukyas and the Rashtrakutas patronised Jainism.
- Jainism was divided into two sects after Vallabhi Council, namely *Svetambaras* (wearing white dresses) under Sthulbhadra and *Digambaras* (naked) under Bhadrabahu.
- The first Jain Council was convened at Pataliputra by Sthulabahu, the leader of the *Digambaras*, in the beginning of the 3rd century B.C.
- The second Jain Council was held at Vallabhi in 5th century A.D. The final compilation of Jain literature called *Twelve Angas* was completed in this council.

BUDDHISM

Gautama Buddha (563-483 B.C.)

- Buddha's original name was *Siddhartha*.
- Siddhartha was born in the Lumbini Garden near Kapilavastu in Nepal. His father was Suddhodana. He was a Sakya chief of Kapilavastu. His mother, Mayadevi, died when Siddhartha was only seven days old. He was brought up by his step mother Mahaprajapati Gauthami.
- At the age of sixteen Siddhartha, married Yasodhara and gave birth to a son, Rahul.
- The sight of an old man, a diseased man, a corpse and an ascetic turned him away from worldly life. He left home at the age of twenty-nine in search of Truth.
- He wandered for seven years and at last, he sat under a bodhi tree at Bodh Gaya in Bihar and did intense penance, after which he got Enlightenment (Nirvana) at the age of

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thirty-five. Since then, he became known as the Buddha or 'the Enlightened One'.

- Buddha delivered his first sermon at Sarnath near Banaras (now Varanasi).
- He died at the age of 80 in 483 B.C. at Kushinagar in Uttar Pradesh.

Teachings of Buddha

- The Four Noble Truths of Buddha are:
  1. The world is full of suffering.
  2. The cause of suffering is desire.
  3. If desires are get rid off, suffering can be removed.
  4. This can be done by following the Eightfold Path.
- The Eightfold Path consists of:
  1. Right Thought.
  2. Right Belief.
  3. Right Speech.
  4. Right Action.
  5. Right Living.
  6. Right Efforts.
  7. Right Knowledge.
  8. Right Meditation.

Buddhist Literature

- In Pali language.
- Buddhist scriptures in Pali are commonly referred to as *Tripitakas, i.e.*, 'Three Baskets'.
- ***Vinaya Pitaka:*** Rules of discipline in Buddhist monasteries.
- ***Sutta Pitaka:*** Largest, contains collection of Buddha's sermons.
- ***Abidhamma Pitaka:*** Explanation of the philosophical principles of the Buddhist religion.

Main Buddhist Councils

Buddhist Council	Time	Place	Chairman	Patron
First	483 BC	Rajagriha	Mahakashyapa	Ajatasatru
Second	383 BC	Vaishali	Sabakamuni	Kalashoka
Third	250 BC	Patliputra	Moggaliputta Tissa	Ashoka
Fourth	AD 72	Kundalvana	Vasumitra, Ashwaghosa	Kanishka

The Mahajanapadas

	Mahajanapadas	Capital
1.	Kashi	Varanasi
2.	Kosala	Shravasti
3.	Anga	Champanagri
4.	Magadh	Girivraj or Rajgriha
5.	Vajji	Vaishali
6.	Malla	Kushinagar and Pavapuri
7.	Chedi	Shuktimati
8.	Vatsa	Kaushambi
9.	Kuru	Hastinapur, Indraprastha and Isukara
10.	Panchal	Ahichhatra and Kampilya
11.	Matsya	Viratnagar
12.	Surasen	Mathura
13.	Asmaka	Paudanya
14.	Avanti	Ujjaini
15.	Gandhara	Taxila
16.	Kamboj	Rajpur (Hatak)

DYNASTIES OF ANCIENT INDIA

HARYANKA DYNASTY

- Bimbisara was the founder of Haryanka Dynasty.
- He was a contemporary of both Vardhamana Mahavira and Gautama Buddha.
- During his rule, Darius I, the Achaemenian emperor, conquered the Indus Valley area.
- Ajatasatru imprisoned his father Bimbisara.
- The first Buddhist Council was convened by Ajatasatru at Rajgir.
- The immediate successor of Ajatasatru was Udayin.
- Udayin laid the foundation of the new capital at Pataliputra situated at the confluence of the two rivers, the Ganges and the Sone.
- Shishunaga was the founder of Shishunaga dynasty.
- After Shishunaga, the mighty empire began to collapse. His successor was Kakavarman or Kalasoka. During his reign, the second Buddhist Council was held at Vaishali.
- Kalasoka was killed by the founder of the Nanda dynasty.

NANDAS

- The fame of Magadha scaled new heights under the Nanda dynasty.
- Mahapadmananda was the founder of Nanda rule in Magadha.
- The last Nanda ruler was Dhana Nanda. Alexander invaded India during his rule.

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MAURYAN EMPIRE

CHANDRAGUPTA MAURYA (322–298 B.C.)

- Chandragupta Maurya was the founder of the Mauryan Empire. He overthrew Nanda dynasty with the help of Chanakya.
- Chandragupta defeated Seleukos Nikator, the Greek general of Alexander, in a battle in 305 B.C.
- Seleukos sent Megasthenes as Greek Ambassador to the Court of Chandragupta. Megasthenes wrote *Indica*.
- Chandragupta was a follower of Jainism.
- He came to Sravana Belgola, near Mysore with a Jain monk called Bhadrabahu. The hill in which he lived until his death is called Chandragiri.
- Chanakya served as prime minister during the reigns of Chandragupta and Bindusara.

BINDUSARA (298–273 B.C.)

- Chandragupta Maurya was succeeded by his son Bindusara.
- Bindusara was called by the Greeks as "*Amitraghatha*" meaning, slayer of enemies.

ASHOKA (273–232 B.C.)

- Ashoka was the most famous ruler of the Mauryan dynasty.
- The most important event of Ashoka's reign was his victorious war with Kalinga in 261 B.C.
- Ashoka convened the Third Buddhist Council at Pataliputra around 250 B.C. in order to strengthen the *Sangha*. It was presided over by Moggaliputta Tissa.
- Ashoka's edicts and inscriptions were deciphered by James Prinsep in 1837.
- The last Mauryan king, Brahadratha was killed by his minister Pushyamitra Sunga. It put an end to the Mauryan Empire.

SUNGAS

- The founder of the Sunga dynasty was *Pushyamitra Sunga*, who was the commander-in-chief under the Mauryas.
- He ascended the throne of Magadha in 185 B.C.
- Pushyamitra was a staunch follower of Brahmanism. He performed two asvamedha sacrifices.
- After the death of Pushyamitra, his son Agnimitra became the ruler.
- Agnimitra was a great conqueror. He was also the hero of the play *Malavikagnimitram* written by Kalidasa.

KANVA

- The last Sunga ruler was Devabhuti, who was murdered by his minister Vasudeva Kanva, the founder of the *Kanva dynasty*.
- The Kanva dynasty ruled for 45 years. After the fall of the Kanvas, the history of Magadha was a blank until the establishment of the Gupta dynasty.

SATAVAHANAS

- The founder of the Satavahana dynasty was Simuka.
- The greatest ruler of the Satavahana dynasty was *Gautamiputra Satakarni*.
- The greatest port of the Satavahanas was Kalyani on the west Deccan. Gandakasela and Ganjam on the east coast were the other important seaports.
- The fine painting at Amaravathi and Nagarjunakonda caves belong to this period.

SANGAM AGE
(300 B.C. TO A.D. 300)

- The Sangam Age constitutes an important chapter in the history of South India.
- According to Tamil legends, there existed three Sangams (Academy of Tamil poets) in ancient Tamil Nadu popularly called Muchchangam. These Sangams flourished under the royal patronage of the Pandyas.
- *The first Sangam*, held at then Madurai, chaired by Agastya.
- *The second Sangam* was held at Kapadapuram, chaired by Tolkappiyar.
- *The third Sangam* at Madurai was founded by Mudathirumaran.

Political History

- The Tamil country was ruled by three dynasties namely the Chera, Chola and Pandyas during the Sangam Age.

CHERAS

- The Cheras ruled over parts of modern Kerala. Their capital was Vanji and their important seaports were Tondi and Musiris.
- The greatest Chera King was *Senguttuvan*.

CHOLAS

- The Chola kingdom of the Sangam period extended from modern Tiruchi district to southern Andhra Pradesh.
- Their capital was first located at Uraiyur and then shifted to Puhar. Kaveripattinam served as their port.

GUPTA PERIOD

- The Gupta period is considered as the *Golden Age* in the history of India because this period witnessed all round developments in Religion, Literature, Science, Art and Architecture.

CHANDRAGUPTA I (320-334 A.D.)

- In the beginning of the 4th Century A.D., Sri Gupta established a small Kingdom at Pataliputra. He is considered as the founder of the Gupta dynasty.

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- The first notable ruler of the Gupta dynasty was Chandragupta I. He assumed the title *Maharajadhiraja*. The Meherauli Iron Pillar inscription mentions his extensive conquests.
- Chandragupta I is considered to be the founder of the Gupta era which starts with his accession in A.D. 320.

SAMUDRAGUPTA (335-380 A.D.)

- Samudragupta was the greatest of the rulers of the Gupta dynasty. The Allahabad Pillar inscription provides a detailed account of his reign.
- Because of his military achievements, Samudragupta was hailed as '*Indian Napoleon*'.

CHANDRAGUPTA II (380-414 A.D.)

- Samudragupta was succeeded by his son Chandragupta II Vikramaditya.
- The greatest of the military achievements of Chandragupta II was his war against the Saka *satraps* of western India.
- The famous Chinese pilgrim, Fahien visited India (A.D. 399 - A.D. 414) during the reign of Chandragupta II.

SUCCESSORS OF CHANDRAGUPTA II

- Kumaragupta (415-455) was the son and successor of Chandragupta II. His reign was marked by general peace and prosperity.
- Kumaragupta was the founder of the Nalanda University.
- Kumaragupta was followed by *Skandagupta* who ruled from A.D. 456 to A.D. 468.
- After Skandagupta's death, many of his successors like Purugupta, Narasimhagupta, Buddhagupta and Baladitya could not save the Gupta empire from the Huns. Ultimately, the Gupta power totally disappeared due to the Hun invasions and later by the rise of Yasodharman in Malwa.

PUSHYABHUTI DYNASTY (600 - 647 A.D.)

- The greatest king was *Harshavardhana*, son of Prabhakar Vardhana of Thaneshwar. He shifted the capital to *Kannauj*.
- *Hieun Tsang* visited during his reign.
- He established a large monastery at Nalanda. Banabhata adorned his court, wrote Harshacharita and Kadambari. Harsha himself wrote three plays–Priyadarshika, Ratnawali and Nagananda.

PALLAVAS

- The Pallavas established their kingdom in Tondaimandalam by Simhavishnu with its capital at Kanchipuram.
- Other great Pallava rulers were Mahendravarman I, Narasimhavarman I, and Narasimhavarman II.
- The *Kailasanatha temple* at Kanchipuram is the greatest architectural masterpiece of the Pallava art.

CHALUKYAS (543-755 A.D.)

- Pulakesin I was the founder of the Chalukya dynasty. He established a small kingdom with Vatapi or Badami as its capital.
- The structural temples of the Chalukyas exist at Aihole, Badami and Pattadakal (Virupaksha temple). Cave temple architecture was also famous under the Chalukyas. Their cave temples are found in Ajanta, Ellora and Nasik.

RASHTRAKUTAS (755-975 A.D.)

- The art and architecture of the Rashtrakutas were found at Ellora and Elephanta.

CHOLAS

- Cholas became prominent in the ninth century and established an empire comprising the major portion of South India. Their capital was Tanjore.
- The founder of the Chola kingdom was Vijayalaya.
- Rajaraja Chola built the famous Brihadeeswara temple at Tanjore.
- *Dancing Figure of Shiva* (Nataraja) belong to Chola period.

MEDIEVAL INDIA

ARAB CONQUEST OF SIND

- In 712 A.D., Muhammad bin Quasim invaded Sind. Quasim defeated Dahir, the ruler of Sind and killed him in a well-contested battle.

Mahmud of Ghazni

- In 1024, Mahmud marched from Multan across Rajaputana, defeated the Solanki King Bhimadeva I, plundered Anhilwada and sacked the famous temple of Somanatha. This was his last campaign in India. Mahmud died in 1030 A.D.
- Mahmud patronized art and literature. *Firdausi* was the poet-laureate in the court of Mahmud.

Muhammad Ghori

- Prithviraj Chauhan defeated Ghori in the first battle of Tarain near Delhi in 1191 A.D.
- In the Second Battle of Tarain in 1192, Muhammad Ghori thoroughly routed the army of Prithiviraj, who was captured and killed.
- After his brilliant victory over Prithviraj at Tarain, Muhammad Ghori returned to Ghazni leaving behind his

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favourite general Qutb-ud-din Aibak to make further conquests in India.

SULTANATE PERIOD

SLAVE DYNASTY (1206-1290)

- The Slave dynasty was also called Mamluk dynasty. Mamluk was the Quranic term for slave.

Qutb-ud-din Aibak

- Qutb-ud-din Aibak was a slave of Muhammad Ghori, who made him the Governor of his Indian possessions.
- After the death of Ghori in 1206, Aibak declared his independence. He assumed the title Sultan and made Lahore his capital.
- Muslim writers call Aibak Lakh Baksh or giver of lakhs because he gave liberal donations to them.
- He built the famous Quwat-Ul-Islam mosque at Delhi. He began the construction of the famous Qutb Minar at Delhi but did not live long to complete it. It was later completed by Iltutmish.

Iltutmish (1210-1236 A.D.)

- Iltutmish belonged to the Ilbari tribe and hence his dynasty was named as Ilbari dynasty.
- He shifted his capital from Lahore to Delhi.
- He organised the *Iqta system* and introduced reforms in civil administration and army.

Raziya (1236-1240 A.D.)

- She appointed an Abyssinian slave Yakuth as Master of the Royal Horses.
- In 1240, Altunia, the governor of Bhatinda revolted against her. She went in personally to suppress the revolt but Altunia killed Yakuth and took Raziya prisoner.
- Bahram Shah, son of Iltutmish killed her.

Balban (1266-1286 A.D.)

- Balban introduced rigorous court discipline and new customs such as prostration and kissing the Sultan's feet to prove his superiority over the nobles.
- He also introduced the Persian festival of *Nauroz* to impress the nobles and people with his wealth and power.
- He established a separate military department - *diwan-i-arz* – and reorganized the army.

KHILJI DYNASTY (1290-1320 A.D.)

- The founder of the Khilji dynasty was Jalaluddin Khilji.
- Ala-ud-din Khilji was the greatest ruler of the Khilji Dynasty.
- He was the first Muslim ruler to extend his empire right upto Rameshwaram in the South.
- The Sultan had built a new city called Siri near Delhi.
- Amir Khusrau the great Persian poet, patronised by Balban, continued to live in Ala-ud-din Khilji's court also.
- He introduced the system of *dagh* (branding of horses) and prepared *huliya* (descriptive list of soldiers).
- Ala-ud-din Khilji maintained a large permanent standing army and paid them in cash from the royal treasury.

TUGHLAQ DYNASTY

- Ghiyas-ud-din Tughlaq was the founder of the Tughlaq dynasty.
- To have the capital at the centre of the empire and safe from the Mongol raids, Tughlaq chose Devagiri as his new capital in A.D. 1327. The Sultan renamed the new capital Daulatabad.
- In 1329-30, Muhammad-bin-Tughlaq introduced a token currency.
- Firoz Shah Tughlaq became Sultan after the death of Muhammad-bin-Tughlaq in A.D. 1351.
- He was the first Sultan to impose irrigation tax.
- He had built new towns of Firozabad, Jaunpur, Hissar and Firozpur.
- Timur—Mongol leader of Central Asia, ordered general massacre in Delhi (AD 1398) at the time of Nasiruddin Mahmud (later Tughlaq king).

SAYYID DYNASTY

- Before his departure from India, Timur appointed Khizr Khan as governor of Multan. He captured Delhi and founded the Sayyid dynasty in 1414.
- Mubarak Shah, Mohammed Shah and Alam Shah were some of the other important noteworthy rulers of Sayyid Dynasty.

LODHI DYNASTY

- The Lodhis were Afghans.
- Bahlol Lodhi was the first Afghan ruler while his predecessors were all Turks. He died in 1489 and was succeeded by his son, Sikandar Lodhi.
- In 1504, Sikandar Lodhi founded the city of Agra and transferred his capital from Delhi to Agra.
- Babar marched against Delhi and defeated and killed Ibrahim Lodhi in the first battle of Panipat (1526).

BAHMANI AND VIJAYANAGAR KINGDOMS

- The break up of the Delhi Sultanate provided an opportunity for the rise of a number of kingdoms in the Deccan.
- After the decline of the Tughlaqs, there arose two important kingdoms in the Deccan. They were the Bahmani and Vijayanagar kingdoms.

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VIJAYANAGAR EMPIRE

- The Vijayanagar Kingdom was set up in A.D. 1336. Its aim was to check the spread of Muslim power and protect Hindu Dharma in South India.
- Four dynasties – Sangama, Saluva, Tuluva and Aravidu – ruled Vijayanagar from A.D. 1336 to 1672.
- Vijayanagar was founded in 1336 by Harihara and Bukka of the Sangama dynasty.
- The Moroccan traveller, Ibn Batuta, Venetian traveller Nicolo de Conti, Persian traveller Abdur Razzak and the Portuguese traveller Domingo Paes were among them who left valuable accounts on the socio-economic conditions of the Vijayanagar Empire.
- The Hampi ruins and other monuments of Vijayanagar provide information on the cultural contributions of the Vijayanagar rulers.

KRISHNA DEVA RAYA (1509-1530)

- The Tuluva dynasty was founded by Vira Narasimha.
- The greatest of the Vijayanagar rulers, Krishna Deva Raya belonged to the Tuluva dynasty.
- Krishna Deva Raya himself authored a Telugu work, *Amukthamalyadha* and Sanskrit works, *Jambavati Kalyanam* and *Ushaparinayam*.
- He built the famous *Vittalaswamy* and *Hazara Ramaswamy* temples at Vijayanagar.
- Krishna Deva Raya renovated Virupaksha temple in A.D. 1510.
- After his death the enemies of Vijayanagar joined together and defeated the Vijayanagar ruler in the battle of Talaikota.

BAHMANI KINGDOM

- The founder of the Bahmani kingdom was Alauddin Bahman Shah also known as Hasan Gangu in 1347. Its capital was Gulbarga.
- Ahmad Wali Shah shifted the capital from Gulbarga to Bidar.
- *Gol Gumbaj* was built by *Muhammad Adil Shah*; it is famous for the so called '*Whispering Gallery*'.
- *Quli Qutub Shah* built the famous *Golcunda Fort*.

MUGHAL EMPIRE
(1526-1707 AD)

BABAR (1526-1530 AD)

- Babar was the founder of the Mughal Empire in India.
- On 21st April, 1526 the first Battle of Panipat took place between Babar and Ibrahim Lodhi, who was killed in the battle.
- Babar was the first one to use guns or artillery in a battle on the Indian soil.
- Babar defeated Rana Sanga of Mewar in the battle of Kanwah in A.D. 1527.
- Babar was a soldier-scholar and wrote his own autobiography called Babar Nama in Turkish language.

HUMAYUN (1530-1556 AD)

- Sher Shah defeated Humayun at Chausa in A.D. 1539 and again at Kannauj in A.D. 1540.
- After losing his kingdom, Humayun became an exile for the next fifteen years.
- In 1555, Humayun defeated the Afghans and recovered the Mughal throne. After six months, he died in 1556 due to his fall from the staircase of his library.
- *Gulbadan Begum*, Humayun's half-sister wrote *Humayun-nama*.

SHER SHAH SURI

- The founder of the Sur dynasty was Sher Shah, whose original name was Farid.
- Sher Shah became the ruler of Delhi in 1540.
- Sher Shah organized a brilliant administrative system. The central government consisted of several departments.
- He built a new city on the banks of the river Yamuna near Delhi. Now the old fort called Purana Quila and its mosque is alone surviving.
- He built a Mausoleum at Sasaram, which is considered as one of the master pieces of Indian architecture.

AKBAR (1556-1605 AD)

- When Akbar ascended the throne in A.D. 1556 he was only 14 years old. His guardian Bairam Khan served him as a faithful minister and tutor.
- Bairam Khan, along with Akbar met Hemu in the second Battle of Panipat in 1556. Hemu was initially successful, but lost his consciousness after an arrow hit him. Akbar killed him.
- The Battle of Haldighati was fought between Rana Pratap of Mewar and Mughal army led by Man Singh and Asif Khan. Some historian say that this battle was indecisive but some say that Rana Pratap was defeated by Akbar.
- Akbar abolished the pilgrim tax and in 1562, he abolished Jaziya.
- Akbar evolved a new faith called Din-i-Illahi or Divine Faith.

JAHANGIR (1605-1627 AD)

- When Akbar died, Prince Salim succeeded with the title Jahangir (Conqueror of World) in 1605.
- Jahangir's eldest son, Khusrau, rebelled against him. He was arrested and put into prison. *Guru Arjun Dev, the fifth Sikh Guru* was executed by Jahangir.
- In 1611, Jahangir married Mehrunnisa who was known as Nurjahan (Light of World).
- Jahangir died in A.D. 1627.

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SHAHJAHAN (1628-1658 AD)

- The reign of Shahjahan is generally considered as the *Golden Age* of the Mughal period.
- Shahjahan is called as the *Prince of Builders*. He had built the Jama Masjid and Red Fort in Delhi and Taj Mahal in Agra.
- Fine arts like painting, music and literature reached high level of development during Shahjahan's time.

AURANGAZEB (1658-1707 AD)

- Aurangazeb was the last great Mughal ruler. He ascended the throne after killing his three brothers Dara, Shuja and Murad in a fratricidal war.
- Aurangazeb defeated Sikandar Shah of Bijapur and annexed his kingdom.
- Aurangazeb was against the Sikhs and he executed the ninth Sikh Guru Tegh Bahadur.
- He was called *Darvesh* or a *Zinda Pir*. He forbade *Sati*. Conquered Bijapur (AD 1686) and Golconda (AD 1687) and reimposed Jaziya and Pilgrim tax in AD 1679.
- He built *Biwi ka Makbara* on the tomb of his queen *Rabaud-Durani* at Aurangabad; *Moti Masjid* within Red Fort, Delhi; and the Jami or Badshahi Mosque at Lahore.
- Aurangazeb died in A.D. 1707.

LATER MUGHALS / FALL OF THE MUGHALS

Bahadur Shah (1707-1712)

- Assumed the title of *Shah Alam I.*

Jahandar Shah (1712-1713)

- First puppet Mughal emperor. He abolished *jaziya*.

Farrukhsiyar (1713-1719)

Mohammad Shah (1719-1748)

- Nadir Shah (*of Iran*) defeated him in the Battle of Karnal (1739) and took away *Peacock throne* and *Kohinoor diamond*.

Ahmad Shah (1748-1754)

Alamgir II (1754-1759),

Shah Alam II (1759-1806)

Akbar II (1806-1837)

- He gave Ram Mohan Roy the title '*Raja*'. He sent Raja Ram Mohan Roy to London to seek a raise in his allowance.

Bahadur Shah II (1837-1857)

- He was confined by the British to the Red Fort. During the revolt of 1857, he was proclaimed the Emperor by the rebels. He was deported to Rangoon after that.

Literature of Mughal Period

Author	Work
Babar	Tuzuk-i-Babari
Abul Fazal	Ain-i-Akbari, Akbarnamah
Jahangir	Tuzuk-i-Jahangiri
Hamid	Padshahnama
Darashikoh	Majm-ul-Bahrain
Mirza Md Qasim	Alamgirnama

THE MARATHAS

SHIVAJI (1627-1680 AD)

- Shivaji was born at Shivner in 1627. His father was Shahji Bhonsle and mother Jija Bai.
- His religious teacher was Samarth Ramdas and guardian was Dadaji Kondadev.
- In 1674, Shivaji crowned himself at Raigarh and assumed the title Chatrapathi.
- *Ashtapradhan* (eight ministers) helped in administration. These were Peshwas, Sar-i-Naubat (Military), Mazumdar or Amatya (Accounts); Waqenavis (Intelligence); Surnavis (Corres-pondence); *Dabir* or *Sumanta* (Ceremonies); *Nyayadhish* (Justice); and *Panditrao* (Charity).
- Successors of Shivaji were Shambhaji, Rajaram and *Shahu* (fought at Battle of Khed in AD 1708).

THE PESHWAS

- Balaji Vishwanath was the first Peshwa. He began his career as a small revenue official and became Peshwa in 1713.
- Baji Rao I was the eldest son of Balaji Vishwanath. He was considered as the "greatest exponent of guerilla tactics after Shivaji".
- It was during reign of Balaji Baji Rao (Nanasaheb) when the Marathas lost the Third Battle of Panipat.
- Baji Rao II (last Peshwa) was the first Maratha to have fled from the British attacks instead of fighting with them. Baji Rao II surrendered to Sir John Malcom.

THE SIKH

- Guru Nanak Dev was the founder of Sikhism, the religion that draws its elements from both Hinduism and Islam.
- Name of the ten Sikh Gurus and their works are given below:
  1. **Guru Nanak Dev (1469-1539AD):** The founder of Sikhism.
  2. **Guru Angad Dev (1504-1552AD):** Developed Gurmukhi.
  3. **Guru Amar Das (1479-1574AD):** Struggled against Sati system and Purdah system.
  4. **Guru Ram Das (1534-1581AD):** Founded Amritsar, the holy city of Sikhism.

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5. **Guru Arjun Dev (1563-1606AD):** He built the *Swarn Mandir* (Golden Temple).
6. **Guru Hargobind (1595-1644 AD):** Established Akal Takht.
7. **Guru Har Rai (1630-1661 AD)**
8. **Guru Har Krishan (1656-1664 AD)**
9. **Guru Tegh Bahadur (1621-1675 AD)**
10. **Guru Gobind Singh (1666-1708 AD):** Founded the Khalsa and Sikh baptism, composed many poems, and nominated the Sikh sacred text as the final and enduring Guru.

MODERN INDIA

THE ADVENT OF THE EUROPEANS

THE PORTUGUESE

- Vasco-da-Gama, a Portuguese explorer, sailed through the route of Cape of Good Hope and reached near Calicut on 20th May 1498 A.D. during the reign of King Zamorin (Hindu King of Calicut).
- Vasco-da-Gama founded a factory at Cannanore on his second visit to India in 1501. In due course, Calicut, Cochin and Cannanore became the Portuguese trading centres.
- Francisco Almeida came to India in 1505. He was the first Governor of Portuguese possessions in India.
- The real founder of Portuguese power in India was *Alfonso de Albuquerque*. He captured Goa from the rulers of Bijapur in 1510. It was made their headquarters.

THE DUTCH

- The United East India Company of the Netherlands founded a factory at Masulipatnam in 1605. They built their first fort on the main land of India at Pulicut in 1609, near Madras (Chennai). They captured Nagapattinam from the Portuguese.
- They made Agra, Surat, Masulipatnam and Chinsura in Bengal as their trading centres.

THE DANES

- The Danish East India Company was established in 1616 in Denmark.
- They came to South India and founded a factory at Tranquebar (Tharangambadi) in 1620. They also made settlements at Serampore near Calcutta (Kolkata).

THE ENGLISH

- The English East India Company was formed in 1599 under a charter granted by Queen Elizabeth in 1600.
- The East India Company sent Sir William Hawkins to the court of the Mughal Emperor Jahangir in 1609 to obtain permission to erect a factory at Surat.
- In 1615, Sir Thomas Roe, another British merchant, came to Jahangir's court. He stayed for three years and succeeded in getting permission to set up their trading centres at Agra, Surat, Ahmedabad and Broach.
- In 1690, the British got permission from Aurangazeb to build a factory on the site of Calcutta. In 1696 a fort was built at that place. It was called Fort William.

THE FRENCH

- The French East India Company was established in 1664 under the inspiring and energetic leadership of Colbert, the economic adviser of the French King Louis XIV.
- In 1667, the first French factory was established at Surat by Francis Caron who was nominated as Director-General.
- French were defeated by English in the *Battle of Wandiwash* (1760).

EAST INDIA COMPANY

- After the Battle of Plassey in 1757 and the Battle of Buxar in 1764, the East India Company became a political power.
- India was under the East India Company's rule till 1858 when it came under the direct administration of the British Crown.
- Robert Clive was the first Governor of Fort William under the Company's rule.

GOVERNOR-GENERALS OF BENGAL

Warren Hastings (1772-85 AD)

- In 1772, the Company appointed Warren Hastings as the Governor of Fort William.
- The Dual System introduced by Robert Clive was abolished by Warren Hastings.
- Warren Hastings was known for his expansionist policy. His administration witnessed the Rohilla War, the First Anglo-Maratha War and the Second Anglo-Mysore War.
- Pitt's India Act (1784) was passed.

Lord Cornwallis (1786-93 AD)

- Cornwallis inaugurated the policy of making appointments mainly on the basis of merit thereby laying the foundation of the Indian Civil Service.
- Lord Cornwallis introduced Permanent Revenue Settlement.
- Tipu Sultan signed the Treaty of Srirangapatnam in 1792 with the British.

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Sir John Shore (1793-98 AD)

- Played an important role in the introduction of Permanent Settlement.
- *Battle of Kharda* between the Nizams and the Marathas (1795).

Wellesley (1798-1805)

- Wellesley came to India with a determination to launch a forward policy that he adopted to achieve his object is known as the 'Subsidiary Alliance'.
- The Fourth Anglo-Mysore War started in 1799. The war was short and decisive. Tipu fought till his capital Srirangapatnam was captured and he himself was shot dead.
- Peshwa Baji Rao II signed the *Treaty* of *Bassein* with the British in 1802. It was a subsidiary treaty and the Peshwa was recognized as the head of the Maratha kingdom.
- The Treaty of Deogaon(1803) was signed between Bhonsle and Wellesley.

Lord Minto (1807-1813)

- Lord Minto concluded the Treaty of Amritsar with Ranjit Singh of Punjab in 1809.
- The Charter Act of 1813 was passed during this period.

Lord Hastings (1813-1823)

- Anglo Nepal War (1814-1816) and Treaty of Sugauli (1816).
- Third Maratha War (1817-18), dissolution of Maratha confederacy and creation of Bombay Presidency.
- He encouraged the freedom of the Press and abolished the censorship introduced in 1799.

GOVERNOR-GENERALS OF INDIA

Lord William Bentinck (1828-1835)

- Charter Act of 1833 was passed and he was made the first Governor-General of India. Before him, the designation was Governor-General of Bengal.
- The social reforms of William Bentinck made his name immortal in the history of British India. These include the abolition of *Sati*, the suppression of Thugs and the prevention of female infanticide.
- The Government Resolution in 1835 made English the official and literary language of India.

Lord Metcalfe (1835-36 AD)

- Known as liberator of press in India.

Lord Auckland (1836-42 AD)

- First Afghan War (1838-42), a disaster for the English.

Lord Ellenborough (1842-44 AD)

- Brought an end to Afghan war. War with Gwalior (1843), *Annexation of Sind* by Charles Napier (1843).

Lord Hardinge (1844-48 AD)

- First Anglo-Sikh War (1845-46) and Treaty of Lahore (1846). Gave preference to English educated persons in employment.

Lord Dalhousie (1848-1856)

- The Doctrine of Lapse was applied by Dalhousie.
- The first railway line connecting Bombay with Thane was opened in 1853.

VICEROYS OF INDIA

Lord Canning (1856-62 AD)

- Lord Canning became the first Viceroy of India in 1858.
- Revolt of 1857, Mutiny took place. Indian Penal Code 1860 was passed.

Lord Elgin (1862 AD)

- Wahabi Movement.

Lord John Lawrence (1864-69 AD)

- Established the *High Courts* at Calcutta, Bombay and Madras in 1865.
- Telegraphic communication was opened with Europe. Created the Indian Forest Department.

Lord Northbrooke (1872-76 AD)

- Kuka Rebellion in Punjab, Famine in Bihar.

Lord Lytton (1876-80)

- In 1878, the Vernacular Press Act was passed. This Act empowered a Magistrate to secure an undertaking from the editor, publisher and printer of a vernacular newspaper that nothing would be published against the English Government. This Act crushed the freedom of the Indian press.
- In 1878, the Arms Act was passed. This Act prevented the Indians to keep arms without appropriate license.
- Lord Lytton also held a Darbar at Delhi in 1877 in which Queen Victoria was declared as the Empress of India. This extravagant Darbar cost millions of ruppes.
- In 1878, the Statutory Civil Service was established exclusively for Indians.

Lord Ripon (1880-84 AD)

- Lord Ripon repealed the Vernacular Press Act and earned much popularity among Indians.
- Ripon appointed a Commission in 1882 under the chairmanship of Sir William Hunter.
- The Commission came to be known as the Hunter Commission. The Commission recommended for the expansion and improvement of the elementary education of the masses.

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- Ripon was founder of local self-government in modern India.

Lord Dufferin (1884-88 AD)

- *Third Burmese War* (1885-86 AD). Establishment of the Indian National Congress in 1885.

Lord Lansdowne (1888-94 AD)

- Factory Act of 1891 granted weekly holiday and stipulated working hours for women and children.

Lord Elgin II (1894-99 AD)

- Southern uprisings of 1899. Great famine of 1896-1897 and Lyall Commission on famine was established.

Lord Curzon (1899-1905 AD)

- Curzon instituted in 1902, a Universities Commission to go into the entire question of university education in the country.
- On the basis of the findings and recommendations of the Commission, Curzon brought in the Indian Universities Act of 1904, which brought all the universities in India under the control of the government.

Lord Minto (1905-10 AD)

- Swadeshi Movement (1905-08); foundation of Muslim League (1906); Surat Session and split in the Congress (1907). Morley-Minto Reforms (1909).

Lord Hardinge (1910-16 AD)

- Capital shifted from Calcutta to Delhi (1911); Delhi Durbar; Partition of Bengal was cancelled. The Hindu Mahasabha was founded in 1915 by Pandit Madan Mohan Malaviya.

Lord Chelmsford (1916-21 AD)

- Gandhi returned to India (1915) and founded the Sabarmati Ashram (1916), Champaran Satyagraha, Satyagraha at Ahmedabad (1981), Kheda Satyagraha (1918).
- Rowlatt Act (March, 1919) and the Jallianwala Bagh Massacre (13th April, 1919).
- Khilafat Committee was formed and Khilafat Movement started (1919-20).
- Non-Cooperation Movement started (1920-22).

Lord Reading (1921-26)

- Moplah Rebellion (1921) took place. *Kakori Train* Robbery on 1st August, 1925. *Communal Riots* of 1923-25 in Multan, Amritsar, Delhi etc.

Lord Irwin (1926-31 AD)

- Lahore Session of Congress and *Poorna Swaraj* Declaration (1929).
- Simon Commission visited India in 1927.
- Dandi March (12th March, 1930). Civil Disobedience Movement (1930).
- First Round Table Conference was held in England in 1930. Gandhi-Irwin Pact.

Lord Willingdon (1931-36 AD)

- *Second Round Table Conference* in London in 1931 and *third* in 1932.

Lord Linlithgow (1936-43 AD)

- Congress Ministries resignation celebrated as '*Deliverance Day*' by the Muslim League (1939), the Lahore Resolution (23rd March, 1940) of the Muslim League demanding separate state for the Muslims. (It was at this session that Jinnah propounded his Two-Nation Theory). Outbreak of World War II in 1939. Cripps Mission in 1942. Quit India Movement (8th August, 1942).

Lord Wavell (1943-47 AD)

- Cabinet Mission Plan (16th May, 1946).
- First meeting of the Constituent Assembly was held on 9th December, 1946.
- Arranged the Shimla Conference on 25th June, 1945 with Indian National Congress and Muslim League but failed.

Lord Mountbatten (March to Aug, 1947)

- Last viceroy of British India and the first Governor-General of free India.
- Partition of India decided by the 3rd June Plan or Mountbatten Plan.

NATIONAL MOVEMENT (1885-1947)

INDIAN NATIONAL CONGRESS (1885)

- Allan Octavian Hume, a retired civil servant in the British Government took the initiative to form an all-India organization. Thus, the Indian National Congress was founded and its first session was held at Bombay in 1885. W.C. Banerjee was its first president. It was attended by 72 delegates from all over India.
- The second session was held in Calcutta in 1886 and the third in Madras in 1887.
- Between 1885 and 1905, the Congress leaders were moderates. The Moderates had faith in the British justice and goodwill. They were called moderates because they adopted peaceful and constitutional means to achieve their demands.
- In 1905, Gopal Krishna Gokhale founded the Servants of India Society to train Indians to dedicate their lives to the cause of the country.

Partition of Bengal (1905)

- By Lord Curzon on 16th October, 1905 through a royal proclamation, reducing the old province of Bengal in size

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by creating East Bengal and Assam out of the rest of Bengal.

- The partition of Bengal in 1905 provided a spark for the rise of extremism in the Indian National Movement.
- Curzon's real motives behind this partition were:
  - To break the growing strength of Bengali nationalism since Bengal was the base of Indian nationalism.
  - To divide the Hindus and Muslims in Bengal.
  - To show the enormous power of the British Government in doing whatever it liked.

Swadeshi Movement (1905)

- The Swadeshi Movement involved programmes like the boycott of government service, courts, schools and colleges and of foreign goods. It was both a political and economic movement.
- Lal, Bal, Pal and Aurobindo Ghosh played an important role.

Muslim League (1906)

- In December 1906, Muslim delegates from all over India met at Dacca for the Muslim Educational Conference.
- Taking advantage of this occasion, Nawab Salimullah of Dacca proposed the setting up of an organisation to look after the Muslim interests. The proposal was accepted.
- The All-India Muslim League was finally set up on December 30, 1906.

Minto Morley Reforms (1909)

- Minto, the Viceroy and Morley, the Secretary of State for India jointly proposed reforms to the Indian Councils. An Act, called the Indian Councils Act or the Minto-Morley Reforms Act was passed in 1909.
- A separate communal electorate was introduced for the Muslims.

The Lucknow Pact (1916)

- During the 1916 Congress session at Lucknow two major events occurred. The divided Congress became united. An understanding for joint action against the British was reached between the Congress and the Muslim League and it was called the Lucknow Pact.
- The signing of the Lucknow Pact by the Congress and the Muslim League in 1916 marked an important step in the Hindu-Muslim unity.

The Home Rule Movement (1916)

- Two Home Rule Leagues were established, one by B.G. Tilak at Poona in April 1916 and the other by Mrs. Annie Besant at Madras in September 1916.
- While Tilak's Movement concentrated on Maharashtra, Annie Besant's Movement covered the rest of the country.

August Declaration

- On 20 August, 1917, Montague, the Secretary of State in England, promised the gradual development of self-governing institutions in India.
- This August Declaration led to the end of the Home Rule Movement.

Rowlatt Act (1919)

- In 1917, a committee was set up under the presidentship of Sir Sydney Rowlatt to look into the militant Nationalist activities. On the basis of its report the Rowlatt Act was passed in March 1919 by the Central Legislative Council. As per this Act, any person could be arrested on the basis of suspicion. No appeal or petition could be filed against such arrests.
- This Act was called the Black Act and it was widely opposed. An all-India hartal was organized on 6 April, 1919.

Jallianwala Bagh Massacre (13 April, 1919)

- On 13th April, the Baisakhi day (harvest festival), a public meeting was organized at the Jallianwala Bagh (garden). Gen. Dyer marched in and without any warning opened fire on the crowd. The firing continued for about 10 to 15 minutes and it stopped only after the ammunition exhausted.
- According to official report 379 people were killed and 1137 wounded in the incident. There was a nationwide protest against this massacre and Rabindranath Tagore renounced his knighthood as a protest.

Khilafat Movement (1920)

- The chief cause of the Khilafat Movement was the defeat of Turkey in the First World War.
- The Muslims in India were upset over the British attitude against Turkey and launched the Khilafat Movement.
- Ali brothers, *Mohd Ali* and *Shaukat Ali* started this movement. It was jointly led by the Khilafat leaders and the Congress.

Non-Co-operation Movement (1920-22)

- Mahatma Gandhi announced his plan to begin Non-Cooperation with the government as a sequel to the Rowlatt Act, Jallianwala Bagh massacre and the Khilafat Movement. It was approved by the Indian National Congress at the Nagpur session in December, 1920.
- The Congress observed the Non-Co-operation movement in 1920. The main aim of this movement was to attain Swaraj through non-violent and peaceful means.
- The whole movement was abruptly called off on 11th February, 1922 by Gandhi following the Chauri-Chaura incident in the Gorakhpur district of U.P. Many top leaders of the country were stunned at this sudden suspension of the Non-Co-operation Movement.

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- On 5th February an angry mob set fire to the police station at *Chauri-Chaura* and twenty two police men were burnt to death.

Swaraj Party

- Leaders like Motilal Nehru and Chittranjan Das formed a separate group within the Congress known as the Swaraj Party on 1 January, 1923.
- The Swarajists wanted to contest the council elections and wreck the government from within.

Simon Commission (1927)

- The Act of 1919 included a provision for its review after a lapse of ten years. However, the review commission under the chairmanship of Sir John Simon was appointed by the British Government two years earlier of its schedule in 1927.
- Indian leaders opposed the commission, as there were no Indians in it, they cried *Simon Go Back*.
- The government used brutal repression and at Lahore, *Lala Lajpat Rai* was severely beaten in lathi-charge.

Nehru Report (1928)

- The Secretary of State, Lord Birkenhead, challenged the Indians to produce a Constitution that would be acceptable to all. The challenge was accepted by the Congress, which convened an all party meeting on 28 February, 1928.
- A committee consisting of eight was constituted to draw up a blueprint for the future Constitution of India. It was headed by Motilal Nehru. The Report published by this Committee came to be known as the Nehru Report.

Lahore Session (1929)

- On Dec. 19, 1929, under the Presidentship of J.L. Nehru, the INC, as its Lahore session, declared Poorna Swaraj (Complete Independence) as its ultimate goal.
- On Dec. 31, 1929, the newly adopted tricolour flag was unfurled and Jan. 26, 1930 was fixed as the First Independence Day, which was to be celebrated every year.

Dandi March (1930)

- On 12th March, 1930, Gandhi began his famous March to Dandi with his chosen 79 followers to break the salt laws. He reached the coast of Dandi on 5 April, 1930 after marching a distance of 200 miles and on 6 April formally launched the Civil Disobedience Movement by breaking the salt laws.

Civil Disobedience Movement

- Countrywide mass participation by women.
- The Garhwal soldiers refused to fire on the people at Peshawar.

Round Table Conference

- The first Round Table Conference was held in November 1930 at London and it was boycotted by the Congress.
- On 8th March, 1931 the Gandhi-Irwin Pact was signed. As per this pact, Mahatma Gandhi agreed to suspend the Civil-Disobedience Movement and participate in the Second-Round Table Conference.
- In September 1931, the Second Round Table Conference was held at London. Mahatma Gandhi participated in the Conference but returned to India disappointed.
- In January 1932, the Civil-Disobedience Movement was resumed.

Poona Pact (1932)

- The idea of separate electorate for the depressed classes was abandoned, but seats reserved for them in the provincial legislature were increased.
- Thus, Poona Pact agreed upon a joint electorate for upper and lower castes.

Demand for Pakistan

- *Chaudhary Rehmat Ali* gave the term *Pakistan* in 1933.
- In March 1940, the Muslim League demanded the creation of Pakistan.

Cripps Mission (1942)

- The British Government in its effort to secure Indian co-operation in the Second World War sent Sir Stafford Cripps to India on 23 March, 1942. This is known as Cripps Mission.
- The main recommendations of Cripps was the promise of Dominion Status to India.
- Congress rejected it. Gandhi called Cripp's proposals as a "Post-dated Cheque".

Quit India Movement (1942-1944)

- The All India Congress Committee met at Bombay on 8th August, 1942 and passed the famous Quit India Resolution. On the same day, Gandhi gave his call of 'do or die'.
- On 8th and 9th August, 1942, the government arrested all the prominent leaders of the Congress. Mahatma Gandhi was kept in prison at Poona. Pandit Jawaharlal Nehru, Abul Kalam Azad, and other leaders were imprisoned in the Ahamednagar Fort.
- Quit India Movement was the final attempt for country's freedom.

Indian National Army (INA)

- On July 2, 1943, Subhash Chandra Bose reached Singapore and gave the rousing war cry of *'Dilli Chalo'*. He was made the President of Indian Independence League and soon became the supreme commander of the Indian National Army. He gave the country the slogan of *Jai Hind.*
- INA had three fighting brigades named after Gandhi, Azad and Nehru. Rani of Jhansi Brigade was an exclusive women force. INA headquarters were at Rangoon and Singapore.

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Cabinet Mission (1946)

- The Cabinet Mission put forward a plan for solution of the constitutional problem. A proposal was envisaged for setting up an Interim Government, which would remain in office till a new government was elected on the basis of the new Constitution framed by the Constituent Assembly.
- Elections were held in July 1946 for the formation of a Constituent Assembly.
- Muslim league observed the *Direct Action Day* on 16 August, 1946.
- An Interim Government was formed under the leadership of Jawaharlal Nehru on 2 September, 1946.

Mountbatten Plan (1947)

- On 20 February 1947, Prime Minister Atlee announced in the House of Commons the definite intention of the British Government to transfer power to responsible Indian hands by a date not later than June 1948.
- Lord Mountbatten armed with vast powers became India's Viceroy on 24 March, 1947. The partition of India and the creation of Pakistan appeared inevitable to him.
- After extensive consultation Lord Mountbatten put forth the plan of partition of India on 3 June, 1947. The Congress and the Muslim League ultimately approved the Mountbatten Plan.

Indian Independence Act, 1947

- The salient features of this Act was the partition of the country into India and Pakistan would come into effect from 15 August, 1947.
- On 15th August, 1947 India, and on the 14th August Pakistan came into existence as two independent states.
- Lord Mountbatten was made the first Governor General of Independent India, whereas Mohammad Ali Jinnah became the first Governor General of Pakistan.
- C. Rajagopalachari became the first and last Indian Governor-General of India. When India became a Republic on 26 January, 1950 Dr. Rajendra Prasad became the first President of our country.

Socio-Religious Movements and Organisation

Name of the Organisation	*Founder*	*Year*	*Place*
Atmiya Sabha	Ram Mohan Roy	1815	Calcutta
Brahmo Samaj	Ram Mohan Roy	1828	Calcutta
Dharma Sabha	Radhakanta Dev	1829	Calcutta
Tattvabodhini Sabha	Debendranath Tagore	1839	Calcutta
Nirankaris	Dayal Das, Darbara Singh, Rattan Chand etc.	1840	Punjab
Manav Dharma Sabha	Durgaram Manchharam	1844	Surat
Paramhansa Mandli	Dadoba Pandurung	1849	Bombay
Namdharis	Ram Singh	1857	Punjab
Radha Swami Satsang	Tulsi Ram	1861	Agra
Brahmo Samaj of India	Keshab Chandra Sen	1866	Calcutta
Dar-ul-Ulum	Maulana Hussain Ahmed	1866	Deoband
Prarthna Samaj	Atmaram Pandurung	1867	Bombay
Arya Samaj	Swami Dayanand Saraswati	1875	Bombay
Theosophical Society	Madam H.P. Blavatsky and Col. H.S. Olcott	1875	New York (USA)
Sadharan Brahmo Samaj	Anand Mohan Bose	1878	Calcutta
Deccan Education Society	G.G. Agarkar	1884	Pune (Poona)
Muhammadan Educational Conference	Syed Ahmad Khan	1886	Aligarh
Indian National Conference	M.G. Ranade	1887	Bombay
Deva Samaj	Shivnarayan Agnihotri	1887	Lahore
Nadwah-ul-Ulama	Maulana Shibli Numani	1894	Lucknow
Ramakrishna Mission	Swami Vivekananda	1897	Belur
Servents of Indian Society	Gopal Krishna Gokhale	1905	Bombay
Poona Seva Sadan	Mrs. Ramabai Ranade and G.K. Devadhar	1909	Pune (Poona)
Social Service League	N.M. Joshi	1911	Bombay
Seva Samiti	H.N. Kunzru	1914	Allahabad

Newspapers and Journals

- *Bengal Gazette* (1780) (India's first newspaper)—James Augustus Hikky
- *Kesari*—B.G. Tilak
- *Maratha*—B.G. Tilak
- *Sudharak*—G.K. Gokhale

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- *Amrit Bazar Patrika*—Shishir Kumar Ghosh and Motilal Ghosh
- *Yugantar*—Bhupendranath Datta and Birender Kumar Ghosh
- *Bombay Chronicle*—Firoze Shah Mehta
- *New India (Daily)*—Annie Besant

Books and Authors

- *Causes of the Indian Mutiny*—Sir Syed Ahmed Khan
- *Ghulam Giri*—Jyotiba Phule
- *Anandmath*—Bankim Chand Chatterjee
- *Satyarth Prakash*—Swami Dayanand
- *Unhappy India*—Lala Lajpat Rai
- *India Divided*—Dr. Rajendra Prasad
- *The Discovery of India*—J.L. Nehru
- *Neel Darpan*—Dinbandhu Mitra
- *Hind Swaraj*—M.K. Gandhi
- *What Congress and Gandhi have done to the untouchables*—Dr. B.R. Ambedkar

Important Sayings

- *'Back to Vedas'*—Dayanand Saraswati
- *'Dilli Chalo!'*—Subhash Chandra Bose's battle cry of *Azad Hind Fauj*
- *'Do or Die'*—Mahatma Gandhi (while launching Quit India movement in 1942)
- *'Give me blood and I will give you freedom'*—Subhash Chandra Bose (in his address to soldiers of *Azad Hind Fauj)*
- *'My ultimate aim is to wipe every tear from every eye'*—Jawaharlal Nehru
- *'Swaraj is my birthright and I will have it'*—Bal Gangadhar Tilak
- *'Inqualab Zindabad'*—Bhagat Singh
- *'Jai Jawan, Jai Kisan'*—Lal Bahadur Shastri
- *'Sarfaroshi ki tamanna Ab Hamare Dil mein Hai'*—Ram Prasad Bismill
- *'Saare Jahan Se Achcha,* Hindustan Hamara'—Dr. Mohammed Iqbal
- *'Hindi, Hindu, Hindustan'*—Bhartendu Harishchandra
- *'Vande Mataram'*—Bankim Chandra Chatterjee

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GEOGRAPHY

WORLD GEOGRAPHY

THE UNIVERSE

- Existing matter and energy are together known as **Universe.**

GALAXY

- A galaxy is a huge system of billions of stars and clouds of dust and gases.
- Our solar system is a part of *Milky Way* galaxy.
- There are millions of galaxies that make the Universe.

STARS

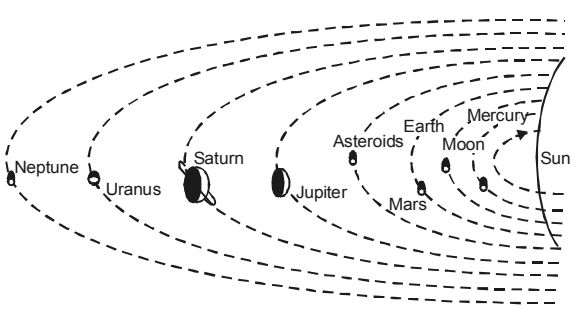
- Stars account for 98 per cent of the matter in a galaxy. The stars nearest to the earth are *Proxima Centauri, Alpha Centauri, Barnard's Star, Sirius* and so on. Of these, *Sirius* is the brightest.

LIGHT YEAR

- Light year is the distance travelled by light in one year at a speed of 2,99,792.5 km. per second.

SOLAR SYSTEM

- The Sun, eight planets, satellites and some other celestial bodies known as asteroids and meteoroids form the solar system.



SUN

- The Sun is in the centre of the solar system.
- The Sun is a mixture of gases. It consists of 92% hydrogen, 7.8% helium and 0.2% other gases.
- The Sun is about 150 million km away from the earth.
- The sun is an ultimate source of energy for life on Earth.
- Sunlight takes 8 min 16.6 sec to reach earth.

Facts about Sun

Diameter	— 1.392 × 10^6 km
Volume	— 1.304 × 106 times the volume of earth
Temperature	— 6000°C at surface and 15 million degree C at the centre
Relative density	— 1.4
Gravitational Pull	— 28 times the gravitational pull of the earth

Facts about Planets

Closest to Sun	*Mercury*
Farthest from Sun	*Neptune*
Heaviest	*Jupiter*
Hottest	*Venus*
Inner	*Mercury, Venus, Earth, Mars*
Largest	*Jupiter*
Smallest	*Mercury*
Moons, None	*Mercury, Venus*
Moon; Largest	*Ganymede (Jupiter), larger than Mercury*
Nearest to Earth	*Venus*
Orbits; Order	*Mercury (closest to Sun), Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune.*
Rings/largest number	*Saturn*
Spin; Backwards	*Venus (East to West)*

COMETS

- It has a head and a tail. Its tail originates only when it gets closer to the sun. The tail can be 20-30 million km long. It always point away from the sun because of the force exerted by solar wind and radiation on the cometory material.

THE EARTH

- The earth is the third nearest planet to the Sun.
- From the outer space, the earth appears blue because its two-thirds surface is covered by water. It is, therefore, called a blue planet.
- It is the densest of all planets.
- Rotation is the movement of the earth on its axis. Due to this rotation, day and night occur.
- The earth takes about 23 hours 56 minutes and 4 seconds to complete one rotation around its axis.
- Earth takes 365¼ days (one year) to revolve around the sun.

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THE EARTH: FACTS AND FIGURES

- *Mass of Earth*—5.972 × 10^{21} tonnes
- *Density of Earth*—5.517 times that of water
- *Volume of Earth*—1.083 × 10^{11} cubic km
- *Equatorial circumference*—4.007 × 104 km
- *Polar Diameter*—12,714 km
- *Equatorial Diameter*—12756 km
- *Polar or Meridional circumference*—4.0 × 10^{4} km
- *Estimated Age*—At least 4600 million years
- *Land Surface*—148,951,000 sq km
- *Water Surface*—361,150,000 sq km (71 per cent of total area)
- *Highest Point of the land surface*—Mt. Everest (8,848 metres)
- *Lowest point of the land surface*—Shores of the Dead Sea (396 metres below the sea level)
- *Greatest Ocean depth*—Mariana Trench, East of Philippines (11,033 metres below the sea level)

THE MOON

- Earth has only one satellite, that is, the moon.
- Its diameter is only one-quarter that of the earth. It is about 3,84,400 km away from us.
- The moon moves around the earth in about 27 days. It takes exactly the same time to complete one spin. As a result, only one side of the moon (only 59% of its surface) is visible to us on the earth.
- Moonlight takes 1.3 sec. to reach earth.

LATITUDE

- Imaginary lines drawn parallel to the equator. Measured as an angle whose apex is at the centre of the earth.
- The equator represents 0° latitude, while the North Pole is 90°N and the South Pole 90°S.
- 23½°N represents Tropic of Cancer while 23½°S represents Tropic of Capricorn.

LONGITUDE

- It is the angular distance measured from the centre of the earth. On the globe the lines of longitude are drawn as a series of semicircles that extend from the North Pole to the South Pole through the equator. They are also called meridians.
- The distance between any two meridians is not equal. At the equator, 1 degree = 111 km. At 30°N or S, it is 96.5 km. It goes on decreasing this way until it is zero at the poles.

INTERNATIONAL DATE LINE

- It is the 180° meridian running over the Pacific Ocean, deviating at Aleutian Islands, Fiji, Samoa and Gilbert Islands.
- Travellers crossing the Date Line from west to east repeat a day and travellers crossing it from east to west lose a day.

INDIAN STANDARD TIME (IST)

- Indian Standard Time is calculated on the basis of 82.5°E longitude which passes through Uttar Pradesh, Madhya Pradesh, Odisha, Chattisgarh and Andhra Pradesh.

ECLIPSES

- Sun is the only source of light for both the Earth and Moon. Eclipses occur when the light thus received is either blocked by the earth or by the Moon.
- Eclipses occur when either the Earth moves behind the Moon's shadow or the Moon moves behind the Earth's shadow.

LUNAR ECLIPSE

- Lunar eclipse occur only when the following conditions are met.
  1. The Sun, Earth and Moon must be aligned in a straight line.
  2. The Earth must be positioned between the Sun and the Moon.
  3. The Moon must be in its full phase (Full Moon).

SOLAR ECLIPSE

- Solar eclipses occur only when the following conditions are met.
  1. The Sun, Earth and Moon must be aligned in a straight line.
  2. The Moon must be positioned between the Sun and the Earth.
  3. Must be a New Moon day.

ROCKS

- Rocks are composed of many minerals such as silica, aluminium, iron and magnesium. The nature of the rock is determined by the presence of its minerals.
- Rocks can be classified into three types:
  1. ***Igneous rocks*** are formed by magma that reaches the earth's surface along deep cracks and at volcanic vents. e.g., Mica, Granite etc.
  2. ***Sedimentary rocks*** are formed by the accumulation and cementation of mud, silt, or sand derived from weathered igneous rock frag-ments. e.g., Gravel, Peat, Gypsum etc.
  3. ***Metamorphic rocks*** are igneous or sedimentary rocks that have been altered by heat and/or pressure, either because they have been buried and folded deep in the crust, or because they have come into contact with molten igneous rock, e.g., Gneiss, Marble, Quartzite etc.

VOLCANOES

Sudden eruption of hot magma (molten rock), gases, ash and other material from inside the Earth to its surface.

- ***Active*** which erupts frequently, e.g., Mauna Loa (Hawaii), Etna (Sicily), Vesuvius (Italy), Stromboli (Mediterranean Sea).

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- ***Dormant*** Not erupted for quite sometime, e.g., Fujiyama (Japan), Krakatoa (Indonesia), Barren Island (Andamans).
- ***Extinct*** Not erupted for several centuries, e.g., Arthur's Seat, Edinburgh, Scotland.

EARTHQUAKES

- Earthquakes are a form of wave energy that is transferred through bedrock. It is transmitted from the point of the earthquake focus, as spherical seismic waves. They travel in all directions outward.
- The intensity of earthquake waves is recorded by *Seismograph*.

LANDFORMS

- There are three major landforms: mountains, plateaus and plains.

MOUNTAINS

- A mountain can be defined as an area of land that rises abruptly from the surrounding region.
- There are three types of mountains- *Fold Mountains, Block Mountains* and the ***Volcanic Mountains***.
- Himalayas, Alps, Andes, Rockies, Atlas, etc are examples of Fold Mountains.
- The Aravali range in India is one of the oldest **fold mountain** systems in the world.
- The Rhine valley and the Vosges mountain in Europe are examples of such mountain systems.
- Volcanic mountains are formed due to volcanic activity.
- Mt. Kilimanjaro in Africa and Mt. Fujiyama in Japan are examples of such mountains.

Major Mountain Ranges of the World

Range	Location	Highest Peak (m)	Length (km)
Andes	South America	6,960	7,200
Himalayas-Karakoram-Hindukush	South Central Asia	8,848	4,800
Rockies	North America	4,401	4,800
Great Dividing Range	East Australia	2,228	3,600
Western Ghat	Western India	2,637	1,610
Caucasus	Europe	5,642	1,200
Alaska	USA	6,194	1,130
Alps	Europe	4,808	1,050
Apennines	Europe	2,912	—
Ural	Asia	1,895	—
Atlas	North West Africa	—	1,930

PLATEAUS

- A plateau is an elevated flat land. It is a flat-topped table land standing above the surrounding area.

Principal Mountain Peaks of the World

Mountains	Height in Metres
1. Mount Everest	8,848
2. K-2 (Godwin Austen)	8,611
3. Kanchenjunga	8,597
4. Lhotse	8,511
5. Makalu I	8,481
6. Dhaulagiri I	8,167
7. Mansalu I	8,156
8. Chollyo	8,153
9. Nanga Parbat	8,124
10. Annapurna I	8,091
11. Gasherbrum I	8,068
12. Broad Peak I	8,047
13. Gasherbrum II	8,034
14. Shisha Pangma (Gosainthan)	8,014
15. Gasherbrum III	7,952

PLAINS

- A relatively low-lying and flat land surface with least difference between its highest and lowest points is called a Plain.

OCEANS

- Oceans of the world is classified into four groups: the Pacific, the Atlantic, the Arctic and the Indian.
- The Pacific is the largest ocean, being twice the size of the Atlantic. It covers about a third of the Earth's surface, and contains more than half the water on the planet.

Oceans of the World

Names	Area (Sq. Km.)	Greatest Depth
Pacific	166,240000	Mariana Trench
Atlantic	86,560000	Puerto Rico Trench
Indian	73430000	Java Trench
Arctic	13230000	—

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Major Rivers of the World

River	Origin	Falls in	Length (Km.)
Nile	Victoria lake	Mediterranean Sea	6,650
Amazon	Andes (Peru)	Atlantic Ocean	6,428
Yangtze	Tibetan Kiang Plateau	China Sea	6,300
Mississippi Missouri	Itaska lake (USA)	Gulf of Mexico (USA)	6,275
Yenisei	Tannu-Ola Mts.	Arctic Ocean	5,539
Hoang Ho	Kunlun Mts.	Gulf of Chibli	5,464
Ob	Altai Mts., Russia	Gulf of Ob	5,410
Congo	Lualaba & Luapula rivers	Atlantic Ocean	4,700
Amur	Northeast China	Sea of Okhotsk	4,444
Lena	Baikal Mts	Laptev Sea	4,400
Mekong	Tibetan Highlands	South China Sea	4,350
Mackenzie	Great Slave Lake	Beaufort Sea	4,241
Niger	Guinea	Gulf of Guinea	4,200

Major Gulfs of the World

Names	Area (Sq. Km.)	Names	Areas (Sq. Km.)
Gulf of Mexico	15,44,000	Gulf of St. Lawrence	2,37,000
Gulf of Hudson	12,33,000	Gulf of California	1,62,000
Arabian Gulf	2,38,000	English Channel	89,900

Important Straits of the World

Straits	Water Bodies joined	Area
Bab-al-Mandeb	Red Sea & Arabian Sea	Arabia & Africa
Bering	Arctic Ocean & Bering Sea	Alaska & Asia
Bosphorus	Black Sea & Marmara Sea	Turkey
Dover	North Sea & Atlantic Ocean	England & Europe
Florida	Gulf of Mexico & Atlantic Ocean	Florida & Bahamas Islands
Gibralter	Mediterranean Sea & Atlantic Ocean	Spain & Africa
Malacca	Java Sea & Bay of Bengal	India & Indonesia
Palk	Bay of Bengal & Indian Ocean	India & Sri Lanka
Magellan	South Pacific & South Atlantic Ocean	Chile
Sunda	Java Sea & Indian Ocean	Indonesia

Important Lakes of the World

Lake	Location	Area (Sq. Km.)
Caspian	Russia and CIS	371000
Superior	Canada and USA	82414
Victoria	Tanzania (Africa)	69485
Huron	Canada and USA	59596
Michigan	USA	58016
Tanganyika	Africa	32892
Baikal	Russia (CIS)	31502
Great Bear	Canada	31080
Malawi	Malawi (Tanzania)	30044
Great Slave	Canada	28438

Highest Waterfalls of the World

Name(s) (Foreign)	Location
Angel (Salto Angel)	Canaima Nat'l Park, Venezuela
Tugela	Natal Nat'l Park, South Africa
Utigord (Utigordsfoss)	Norway
Monge (Mongefoss)	Marstein, Norway
Gocta Cataracts	Chachapoyas, Peru
Mutarazi (Mtarazi)	Nyanga Nat'l Park, Zimbabwe
Yosemite	Yosemite Nat'l Park, California, U.S.
Espelands (Espelandsfoss)	Hardanger Fjord, Norway
Lower Mar Valley (Ostra Mardolafoss)	Eikesdal, Norway
Tyssestrengene	Odda, Norway

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Important Cities on River Banks (World)

City	Country	River
Adelaide	Australia	Torrens
Amsterdam	Netherlands	Amsel
Alexandria	Egypt	Nile
Ankara	Turkey	Kazil
Bangkok	Thailand	Chao Praya
Basra	Iraq	Eupharates and Tigris
Baghdad	Iraq	Tigris
Berlin	Germany	Spree
Bonn	Germany	Rhine
Budapest	Hungary	Danube
Bristol	UK	Avon
Buenos Aires	Argentina	Laplata
Chittagong	Bangladesh	Majyani
Canton	China	Si-Kiang
Cairo	Egypt	Nile
Chung King	China	Yang-tse-kiang
Cologne	Germany	Rhine
Dandzing	Germany	Vistula
Dresden	Germany	Elbe
Dublin	Ireland	Liffy
Hamburg	Germany	Elbe
Kabul	Afghanistan	Kabul
Karachi	Pakistan	Indus
Khortoum	Sudan	Confluence of Blue & White Nile
Lahore	Pakistan	Ravi
Leningrad	Russia	Neva
Lisbon	Portugal	Tagus
Liverpool	England	Messey
London	England	Thames
Moscow	Russia	Moskva
Montreal	Canada	St. Lawrence
Nanking	China	Yang-tse-kiang
New Orleans	U.S.A.	Mississipi
New York	U.S.A.	Hudson
Ottawa	Canada	Ottawa
Paris	France	Seine
Philadelphia	U.S.A	Delaware
Perth	Australia	Swan
Prague	Czech Republic	Vitava
Quebec	Canada	St. Lawrence
Rome	Italy	Tiber
Rotterdam	The Netherlands	New Moss
Stalingrad	Russia	Volga
Shanghai	China	Yang-tse-kiang
Sidney	Australia	Darling
Saint Louis	U.S.A	Mississippi
Tokyo	Japan	Arakava
Vienna	Austria	Danube
Warsaw	Poland	Vistula
Washington D.C.	U.S.A.	Potomac
Yangoon	Myanmar	Irawaddy

World's Geographical Surnames

City of Sky-scrapers—New York
City of Seven Hills—Rome
City of Dreaming Spires—Oxford
City of Golden Gate—San Francisco
City of Magnificent Buildings—Washington D.C.
City of Eternal Springs—Quito (S. America)
China's Sorrow—Hwang Ho
Cockpit of Europe—Belgium
Dark Continent—Africa
Emerald Isle—Ireland
Eternal City—Rome
Empire City—New York
Forbidden City—Lhasa (Tibet)
Garden City—Chicago
Gate of Tears—Strait of Bab-el-Mandeb
Gift of the Nile—Egypt
Granite City—Aberdeen (Scotland)
Hermit Kingdom—Korea
Herring Pond—Atlantic Ocean
Holy Land—Jerusalem
Island Continent—Australia
Islands of Cloves—Zanzibar
Isle of Pearls—Bahrein (Persian Gulf)
Key to the Mediterranean—Gibralter
Land of Cakes—Scotland
Land of Golden Fleece—Australia
Land of Maple Leaf—Canada
Land of Morning Calm—Korea
Land of Midnight Sun—Norway
Land of the Thousand Lakes—Finland
Land of the Thunderbolt—Bhutan
Land of White Elephant—Thailand
Land of Thousand Elephants—Laos
Land of Rising Sun—Japan
Loneliest Island—Tristan De Gunha (Mid-Atlantic)
Manchester of Japan—Osaka
Pillars of Hercules—Strait of Gibraltar
Pearl of the Antilles—Cuba
Playground of Europe—Switzerland
Quaker City—Philadelphia
Queen of the Adriatic—Venice
Roof of the World—The Pamirs, Central Asia
Sugar bowl of the world—Cuba
Venice of the North—Stockholm

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Windy City—Chicago
Whiteman's grave—Guinea Coast of Africa
Yellow River—Huang Ho (China)
Sickman of Europe—Turkey

Important Boundaries

Durand Line	Pakistan & Afghanistan
MacMohan Line	India & China
Radcliff Line	India & Pakistan
Maginot Line	France & Germany
Oder Niesse Line	Germany & Poland
Hindenberg Line	Poland & Germany (at the time of First World War)
38th Parallel	North & South Korea
49th Parallel	USA & Canada

Continents: Some Facts

Continent	Biggest Counrty	Highest Peak	Longest River
Asia	China	Mt. Everest (8848 m)	Yangtze Kiang
Africa	Algeria	Mt. Kilimanjaro (5895 m)	Nile
North America	Canada	Mt. Mckinley (6194 m)	Mississippi Missouri
South America	Brazil	Mt. Acancagua (6960 m)	Amazon
Europe	Russia	Mt. Elbrus (5642 m)	Ob
Australia	Australia	Mt. Coscuisco (2228 m)	Darling
Antarctica	—	Vinson Massif (5140 m)	—

INDIAN GEOGRAPHY

AREA AND LOCATION

- India is in the southern parts of the Asian continent. In the west of India lies the Arabian Peninsula while in the east lies the Indo-China Peninsula.
- India extends between 8°4' N and 37°6' N latitudes and between 68°7' E and 97°2' E longitudes.
- India, has a total geographic area of 32,87,263 sq. km. This is only 2.42 % of the total geographic area of the world but holds 17 per cent of the world's population.
- The 23½ºN, which is the Tropic of Cancer, runs across the country.
- India has a length of 3214 km from north to south and 2933 km from east to west. It has a land frontier of 15200 km.
- The total length of the coastline of the mainland, Lakshadweep Islands and Andaman and Nicobar Islands is 7,516.6 km.
- India ranks seventh among the countries of the world, in terms of the geographical extent.
- India is bordered on three sides by water and on one by land, it is also a peninsula.
- India shares its common border with Afghanistan and Pakistan in the north-west, China and Bhutan in the north, and Bangladesh in the east. In the south, Sri Lanka is separated from India by a strait, known as the Palk Strait.
- There are 28 States (After reorganisation of J&K in 2019) and 8 Union Territories (After merger of Dadra & Nagar Haveli and Daman & Diu in 2020).
- 82°30' E longitude is considered as the Indian Standard Meridian. The local time of this longitude is taken as the Indian Standard Time (IST). This is 5½ hours ahead of the Greenwich Mean Time.

THE INDIAN STATES ON INTERNATIONAL BOUNDARIES ARE:

- ***Bordering Pakistan:*** Jammu and Kashmir, Punjab, Rajasthan, Gujarat.
- ***Bordering China:*** Ladakh, Himachal Pradesh, Uttarakhand, Sikkim, Arunachal Pradesh.
- ***Bordering Nepal:*** Bihar, Uttarakhand, UP, Sikkim, West Bengal.
- ***Bordering Bangladesh:*** West Bengal, Mizoram, Meghalaya, Tripura, Assam.
- ***Bordering Bhutan:*** West Bengal, Sikkim, Arunachal Pradesh, Assam.
- ***Bordering Myanmar:*** Arunachal Pradesh, Nagaland, Manipur, Mizoram.
- ***Bordering Afghanistan:*** Jammu and Kashmir (Pakistan-occupied area).

Important Passes

Kashmir	Burzi-La, Joji-La
Himachal Pradesh	Bara La, Cha-La, Shipki-La
Uttarakhand	Niti-La, Lipu-Lekh-La
Sikkim	Jelep-La, Nathu-La
Arunachal Pradesh	Bomdi-La

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Heighest Mountain Peaks of India

Peaks	Elevation• (in mts.)
Godwin Austin (K2)	8611
Kanchenjunga	8598*
Nanga Parvat	8126*
Gasherbrum	8068*
Broad Peak	8047*
Dastegil	7885*
Masherbrum (East)	7821*
Nanda Devi	7817
Masherbrum (West)	7806*
Rakoposhi	7788*
Kamet	7756
Saser Kangdi	7672

• *Above mean sea level in metres.*

* *Situated in Pak occupied Kashmir (PoK).*

Towns at River Banks

Town	River
Agra	Yamuna
Allahabad	Confluence of the Ganges and the Yamuna
Ayodhya	Saryu
Badrinath	The Ganges
Kolkata	Hooghly
Cuttuck	Mahanadi
Delhi	Yamuna
Dibrugarh	Brahmaputra
Ferozepur	Satluj
Guwahati	Brahmaputra
Hardwar	The Ganges
Hyderabad	Musi
Jabalpur	Narmada
Kanpur	The Ganges
Kota	Chambal
Kurnool	Tungbhadra
Lucknow	Gomti
Ludhiana	Sutlej
Nasik	Godavari
Pandharpur	Bhima
Patna	The Ganges
Sambalpur	Mahanadi
Srinagar	Jhelum
Srirangapattam	Cauveri
Surat	Tapti
Varanasi	The Ganges
Vijaywada	Krishna

Waterfalls of India

Waterfall	Hgt (Mt.)	River	State
Jog/Gersoppa	260	Sharavati	Karnataka
Rakim Kund	168	Gaighat	Bihar
Chachai	127	Bihad	Madhya Pradesh
Kevti	98	Mahanadi	Madhya Pradesh
Sivasamudram	90	Cauveri	Karnataka
Kunchikal	45.5	Varani	Karnataka

Important Lakes of India

Name of lake	State/UT
Pulicat Lake	Tamil Nadu & Andhra Pradesh Border
Sambhar Lake	Rajasthan
Tso Moriri Lake	Jammu & Kashmir
Vembanad Lake	Kerala
Wular & Dal Lakes	Jammu and Kashmir
Chilka Lake	Odisha
Kolleru Lake	Andhra Pradesh
Loktak Lake	Manipur
Lonar Lake	Maharashtra
Pangong Lake	Ladakh

Rivers of India

Name	Originates From	Falls Into
Yamuna	Yamunotri	Ganga
Chambal	Singar Chouri Peak, Vindhyan escarpment	Yamuna
Ghaghara	Matsatung Glacier	Ganga
Kosi	Near Gosain Dham Peak	Ganga
Sabarmati	Aravalis	Gulf of Khambat
Krishna	Western Ghats	Bay of Bengal
Godavari	Nasik district in Maharashtra	Bay of Bengal
Caurey	Brahmagir Range of Western Ghats	Bay of Bengal
Tungabharda	Western Ghats	Krishna
Ganges	Combines Sources	Bay of Bengal

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Name	Originates From	Falls Into
Sutlej	Mansarovar Rakas lakes	Chenab
Indus	Near Mansarovar Lake	Arabian Sea
Ravi	Kullu Hills near Rohtang Pass	Chenab
Beas	Near Rohtang Pass	Sutlej
Jhelum	Verinag in Kashmir	Chenab
Son	Amarkantak	Ganga
Brahmaputra	Near Mansarovar Lake	Bay of Bengal
Narmada	Amarkantak	Gulf of Khambat
Tapti	Betul District in Madhya Pradesh	Gulf of Khambat
Mahanadi	Raipur District in Chhattisgarh	Bay of Bengal
Luni	Aravallis	Rann of Kuchchh
Ghaggar	Himalayas	Near Fatehabad
Betwa	Vindhyanchal	Yamuna

Geographical Surnames

Bengal's Sorrow	Damodar River	City of Lakes	Srinagar
City of Palaces	Kolkata	Twin City	Hyderabad-Secunderabad
Gateway of India	Mumbai	City of Seven Islands	Mumbai
Pink City	Jaipur	Diamond Harbour	Kolkata
Paris of India	Jaipur	Switzerland of India	Kashmir
Manchester of India	Ahmedabad	Rice Bowl	Chhattisgarh
Kashmir of South	Kerala	Fruit Bowl	Himachal Pradesh
Son of Sea	Lakshadweep	Ganga of South	Cauvery
Queen of Mountains	Mussourie	Pitsburg of India	Jamshedpur
Iron City	Jamshedpur	City of Bridges	Srinagar
Hollywood of India	Mumbai	Residence of God	Allahabad
Scotland of East	Meghalaya	A Cross-road (Quadrivial) of National Highways	Kanpur
City of Nababs	Lucknow	Heart of India	Delhi
City of Temples & Ghats	Varanasi	Black River	Sharda
Land of Five Rivers	Punjab	City of Festivals	Madurai
City of Golden Temple	Amritsar	Queen of Deccan	Pune
Garden of India	Bangaluru	Sorrow of Bihar	Kosi River
Spice Garden of India	Kerala		

Some Major Irrigational and Multipurpose Projects

S.No.	Name of Project	Related State	River
1.	Bargi Project	Madhya Pradesh	Bargi
2.	Beas	Joint Venture of Haryana, Punjab and Rajasthan	Beas
3.	Bhadra	Karnakata	Bhadra
4.	Bhakra Nangal	Haryana, Punjab and Rajasthan	Sutluj
5.	Bhima I	Maharashtra	Pawana
6.	Bhima II	Maharashtra	Krishna
7.	Chambal	Joint Project of M.P. and Rajasthan	Chambal
8.	Damodar Valley Project	West Bengal and Bihar	Damodar
9.	Dulhasti Power Project	Jammu and Kashmir	Chenab
10.	Farakka	West Bengal	Hooghly

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S.No.	Name of Project	Related State	River
11.	Gandak	Bihar and U.P.	Gandak
12.	Ghataprabha	Karnataka	Ghataprabha
13.	Hasdeo Bango Project	Madhya Pradesh, Chhattisgarh	Hasdeo
14.	Hirakud	Odisha	Mahanadi
15.	Jayakwadi	Maharashtra	Godavari
16.	Kakrapara	Gujarat	Tapti
17.	Kangsbati	West Bengal	Kangsbati and Kumari
18.	Karjan	Gujarat	Karjan
19.	Kosi	Bihar	Kosi
20.	Koyana	Maharashtra	Koyana
21.	Krishna Project	Maharashtra	Krishna
22.	Kukadi	Maharashtra	Kukadi
23.	Left Bank Ghagra Canal	Uttar Pradesh	Ghagra
24.	Madhya Ganga Canal	Uttar Pradesh	Ganga
25.	Mahanadi Delta Scheme	Odisha	(The irrigation scheme will utilise releases from Hirakund Reservoir)
26.	Mahi	Gujarat	Mahi
27.	Malaprabha	Karnataka	Malaprabha
28.	Mayurakshi	West Bengal	Mayurakshi
29.	Nagarjunasagar	Andhra Pradesh	Krishna
30.	Panam	Gujarat	Panam
31.	Parambikulam Aliyar	Tamil Nadu and Kerala	Perimbikulam
32.	Pochampad	Andhra Pradesh	Godavari
33.	Pong Dam	Punjab	Beas
34.	Ramganga	Uttarakhand	Ramganga
35.	Ranjit Sagar Dam (Thein Dam)	Punjab	Ravi
36.	Rihand	Uttar Pradesh	Rihand
37.	Sabarmati	Gujarat	Sabarmati
38.	Sharda Sahayak	U.P.	Ghagra
39.	Sone High Level Canal	Bihar	Sone
40.	Tawa	Madhya Pradesh	Tawa
41.	Tehri Dam	Uttarakhand	Bhagirathi
42.	Tungabhadra	Andhra Pradesh and Karnataka	Tungabhadra
43.	Ukai	Gujarat	Tapti
44.	Upper Krishna	Karnataka	Krishna
45.	Upper Penganga	Maharashtra	Penganga
46.	Uri Power Project	Jammu and Kashmir	Jhelum

Major Indian Crops

Crops	Temp(°c)	Water(cm)	States where Produced
Wheat	15°-25°	60-90	Uttar Pradesh, Punjab, Haryana.
Rice	24°-26°	80-200	West Bengal, Uttar Pradesh, Andhra Pradesh, Bihar, Punjab
Maize	18°-21°	50-60	Karnataka, Uttar Pradesh, Maharashtra
Jowar	20°-35°	40-60	Maharashtra, Madhya Pradesh, Karnataka
Soyabean	25°-27°	50-120	Madhya Pradesh
Cotton	20°-30°	80-150	Maharashtra, Gujarat, Karnataka, Madhya Pradesh
Tobacco	20°-25°	75-80	Andhra Pradesh, Madhya Pradesh, Gujarat, Karnataka, Maharashtra, Uttar Pradesh
Tea	24°-30°	100-200	Assam, West Bengal, Kerala, Tamil Nadu, Uttar Pradesh
Ground Nut	15°-25°	60-130	Gujarat, Maharashtra

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Mineral Wealth at a Glance (Metallic Minerals)

Mineral	Chief Producers
Bauxite	Odisha, Gujarat, Jharkhand
Chromite	Odisha, Karnataka
Coal	Jharkhand, Odisha
Copper	Rajasthan, Madhya Pradesh
Diaspore	Uttar Pradesh, Madhya Pradesh
Gold	Karnataka
Iron	Odisha, Karnataka, Goa
Lead	Rajasthan, Andhra Pradesh
Lignite	Tamil Nadu, Jammu & Kashmir
Manganese	Odisha, Karnataka
Natural Gas	Gujarat, Assam
Petroleum	Gujarat, Assam, Andhra Pradesh
Silver	Rajasthan, Jharkhand, Gujarat
Tungsten	Rajasthan
Zinc	Rajasthan, Maharashtra

Zones and Headquarters of Indian Railways

S.No.	Zone	Headquarters
1.	Central	Mumbai (Victoria Terminus)
2.	Eastern	Kolkata
3.	Northern	New Delhi
4.	North-Eastern	Gorakhpur
5.	North-East Frontier	Maligaon, Guwahati
6.	Southern	Chennai
7.	South-Central	Secunderabad
8.	South-Eastern	Kolkata
9.	Western	Mumbai, Churchgate
10.	East Coast	Bhubaneswar
11.	East Central	Hajipur
12.	North Central	Allahabad
13.	North Western	Jaipur
14.	South Western	Bengaluru (Hubli)
15.	West Central	Jabalpur
16.	South East Central	Bilaspur
17.	Metro Railway	Kolkata
18.	South Coast Railway	Vishakhapatnam

Major National Highways

N H	Connects
NH 1	New Delhi-Ambala-Jalandhar-Amritsar
NH 2	Delhi-Mathura-Agra-Kanpur-Allahabad-Varanasi-Kolkata
NH 3	Agra-Gwalior-Nasik-Mumbai
NH 4	Thane and Chennai *via* Pune and Belgaum
NH 5	Kolkata-Chennai
NH 6	Kolkata-Dhule
NH 7	Varanasi-Kanyakumari (2369 km)
NH 8	Delhi-Mumbai (*via* Jaipur, Baroda and Ahmedabad)
NH 9	Mumbai-Vijaywada
NH 10	Delhi-Fazilka
NH 24	Delhi-Lucknow
NH 26	Lucknow-Varanasi

Major Ports of Country

1. Kolkata
2. Mumbai
3. Nhava Sheva (J.L. Nehru Port)
4. Tuticorin
5. Chennai
6. Mormugao
7. New Mangalore
8. Paradeep
9. Kandla
10. Vishakhapatnam
11. Cochin
12. Haldia
13. Ennore.

Major International Airports in India

International Airports	City
Indira Gandhi International Airport	Delhi
Anna International Airport	Chennai
Sri Guru Ram Dass Ji International Airport	Amritsar
Rajiv Gandhi International Airport	Hyderabad
Calicut International Airport	Calicut
Chhatrapati Shivaji International Airport	Mumbai
Kempegowda International Airport	Bengaluru
Goa Airport in Vasco di Gama City	Goa
Netaji Subash Chandra Bose International Airport	Kolkata
Thriuvananthapuram International Airport	Thiruvananthapuram
Lokpriya Gopinath Bordoloi International Airport	Guwahati
Sardar Vallabhbhai Patel International Airport	Ahmedabad

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INDIAN POLITY

INDIAN CONSTITUTION

- Demand for a Constituent Assembly composed of the people of India officially asserted by the Congress for the first time in 1935.
- The election for Indian Constitution Assembly held in 1946 according to the *Cabinet Mission Plan*.
- The first session of the Assembly was held in New Delhi on December 9, 1946. *Sachidanand Sinha* was elected provisional chairman of the session.
- On December 11, 1946, Dr. Rajendra Prasad was elected as the Permanent Chairman of the Constituent Assembly.
- The Constitution was framed by the Constituent Assembly of India, set-up in December 1946, in accordance with the Cabinet Mission Plan, under the Chairmanship of Sachidanand Sinha, initially.
- The total membership of Constituent Assembly after partition was 299, among them 70 were representatives from the Indian states and others from British India.
- The Chairman of the Drafting Committee was **Dr. BR Ambedkar**, also called the Father of the Constitution.
- The Constituent Assembly took 2 years, 11 months and 18 days to complete the Constitution.
- The Constitution, adopted on 8th November, 1949, contained 395 Articles and Schedules.
- The Constitution was delayed till 26th January because, in 1929, on this day Indian National Congress demanded Poorna Swaraj in Lahore Session under JL Nehru.
- Indian Constitution is a comprehensive document and it is the lengthiest written Constitution in the World.

THE PREAMBLE

- ***The Preamble of the Constitution:*** "We the people of India, having solemnly resolved to Constitute India into a Sovereign, Socialist, Secular Democratic Republic and to secure to all its citizen:

  Justice, Social, economic and political;

  Liberty of thought, expression, belief, faith and worship;

  Equality of status and of opportunity; and to promote among them all;

  Fraternity assuring the dignity of the individual and the unity and integrity of the nation;

  In our Constituent Assembly, this twenty-sixth day of November, 1949, do hereby adopt, enact and give to ourselves this constitution."

Foreign Sources of Indian Constitution

Foreign Sources	*Subject*
Britain	Parliamentary system, collective responsibilities of Cabinet
America	Fundamental right, Independent Judiciary, Judicial review
Canada	Division of powers
Ireland	Directive principles
Germany	Emergency provisions
Russia	Fundamental duties
Australia	Concurrent list

IMPORTANT ARTICLES

PART - I

UNION AND ITS TERRITORIES (ARTICLE 1 - 4)

- The Constitution says, "India, that is Bharat, shall be a Union of States".
- Parliament has the power to create any State, reduce it, change the name of boundaries of any State.

PART - II

CITIZENSHIP (ARTICLE 5 - 11)

- The Constitution provides for a single Citizenship.
- ***Indian Citizenship can be acquire:***
  1. by birth
  2. by descent
  3. by registration
  4. by naturalisation
  5. by incorporation of territory
- ***Indian Citizenship can be lost by:***
  1. renunciation;
  2. termination — it takes place if a citizen of India voluntary acquires the citizenship of another country; and
  3. deprivation — if the Government terminates the citizenship.

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PART - III

FUNDAMENTAL RIGHTS (ARTICLE 12 - 35)

- Following fundamental rights are enjoyed by every Indian citizen, irrespective of caste, colour, creed and sex:
  1. ***Right to Equality:*** No special privileges, no distinction on grounds of religion, caste, creed and sex.
  2. ***Right to Freedom:*** The right to freedom of expression and speech, the right to choose one's own profession, the right to reside in any part of the Indian Union.
  3. ***Right to Freedom to Religion:*** Except when it is in the interest of public order, morality, health or other conditions, everybody has the right to profess, practice and propagate his religion freely.
  4. ***Cultural and Educational Rights:*** The Constitution provides that every community can run its own institutions to preserve its own culture and language.
  5. ***Right against Exploitation:*** Traffic in human beings and forced labour and the employment of children under 14 years in factories or mines, are punishable offences.
  6. ***Rights to Constitutional Remedies:*** When a citizen finds that any of his fundamental rights has been encroached upon, he can move the Supreme Court, which has been empowered to safeguard the fundamental rights of a citizen (Article 32).

PART - IV

DIRECTIVE PRINCIPLES OF STATE POLICY (ARTICLE 36 - 51)

- Directive principles are not enforceable through courts. Main aim of Directive principles is to provide social and economic base of a genuine democracy.

Some Important Directive Principles:

- Provisions for adequate means of livelihood for all citizens (Art. 39).
- Right to work (Art. 41).
- Right to human condition of work and maternity relief (Art. 42).
- Right to a living wage and condition of work ensuring decent standard of life of worker (Art. 43).
- Common Civil Code (Art. 44).
- Prohibit consumption of liquor (Art. 47).
- Prevent slaughter of useful cattle (Art. 48).
- Organise Panchayati Raj (Art. 40).
- Separate the judiciary from the executive (Art. 50).
- Protect and maintain places of historic monuments (Art. 49).
- International peace (Art. 51).

PART - IV A

FUNDAMENTAL DUTIES (ARTICLE 51A)

- The fundamental duties for the Indian citizens have been incorporated in the Constitution through the Constitution (42nd) Amendment Act, 1976. These duties are:
  1. to abide by the Constitution and respect its ideals and institutions, the National Flag and the National Anthem;
  2. to cherish and follow the noble deeds which inspired our national struggle for freedom;
  3. to uphold and protect the sovereignty, unity and integrity of India;
  4. to defend the country and render national service when called upon to do so;
  5. to promote harmony and the spirit of common brotherhood amongst all the people transcending religious, regional or sectional diversities and to renounce practices derogatory to the dignity of women;
  6. to value and preserve the rich heritage of our composite culture;
  7. to protect and improve natural environment including forests, lakes, rivers and wildlife, and to have compassion for living creatures;
  8. to develop the scientific temper, humanism and the spirit of inquiry and reform;
  9. to safeguard public property and to abjure violence;
  10. to strive towards excellence in all spheres of individual and collective activity so that the nation constantly rises to higher levels of endeavour and achievement.
  11. who is parent or guardian to provide opportunities for education to his child or, as the case may be, ward between age of six and fourteen years.

PART - V

UNION (ARTICLE 52 - 151)

THE PRESIDENT

- The President is the Constitutional head of the Republic of India. He is more or less the titular head of the executive.
- He is the constitutional head but not the real executive. The real power is vested in the hands of the Council of Ministers.
- President is the first citizen of India.
- ***Qualifications:*** (i) Indian citizen, (ii) age not less than 35 years, (iii) should have qualification for election to Lok Sabha, (iv) should not hold any office of profit, (v) should not be a Member of Parliament or State Legislature.
- ***Election:*** Indirectly elected through Electoral College consisting of elected members of both the Houses of the Parliament and elected members of the Legislative Assemblies of the States.
- According to the 70th Amendment Act, 1992, the expression 'States' include the National Capital Territory of Delhi and the Union Territory of Puducherry. Members of the Legislative Councils have no right to vote in the Presidential election.

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- ***Powers:*** He makes appointments to all the constitutional posts.
- He can address either House of Parliament and dissolve Lok Sabha.
- All Bills passed by Parliament must receive his assent to become an Act.
- He issues ordinances when Parliament is not in session. No Money Bill can be introduced in Lok Sabha without his recommendation.
- He appoints 12 members of special repute in the Rajya Sabha.
- He has the power of *Pardon* to a criminal in special cases.
- The President holds the office for a period of five years. He is eligible for re-election.
- He draws a fix salary per month with various allowances.
- He is also entitled to rent free official residence called Rashtrapati Bhawan.

VICE-PRESIDENT

- ***Article 63*** of the Constitution stipulates a Vice-President for India.
- The Vice-President acts as the ex-officio Chairman of the Council of States (Rajya Sabha).
- He is elected by an electoral college consisting of the members of both Houses of Parliament in accordance with the system of proportional represen-tation by means of the single trans-ferable vote. He must be a citizen of India, not less than 35 years of age, and should be eligible for election as a member of the Council of States.
- Disputes in connection with election of a president or a vice-president are to be a dealt with in accordance with Article-71. Such disputes shall be decided by the Supreme Court.

COUNCIL OF MINISTERS

- The Constitution of India provides for a parliament system of government under which the President is only Constitutional ruler and the real power is exercised by the Council of Ministers, headed by the Prime Minister.
- Council of Ministers is composed of all Union Ministers—the Prime Minister, Cabinet Ministers and Ministers of State.
- The Council of Ministers is Collectively responsible to the Lok Sabha.
- The Prime Minister is a link between the President and the Council of Ministers.

PRIME MINISTER

- The Prime Minister is the leader of the majority party in the Parliament.
- He is appointed by the President. Other Ministers are appointed by the president on his advice.
- The Prime Minister is the head of the Government and the head of the Council of Ministers.
- Jawaharlal Nehru was the first Prime Minister and the longest serving so far.

UNION LEGISLATURE

- The Legislature of the Union, which is called 'Parliament' consists of the President and the two Houses of Parliament known as the Council of states (Rajya Sabha) and the House of the People (Lok Sabha).

RAJYA SABHA

- The Rajya Sabha is the Upper House of the Parliament and it is constituted of representatives from the States or the Constituent units of the Indian Union.
- It is a permanent body, one third of its members retiring after every two years.
- Its maximum strength is 250. Out of these, twelve members are nominated by the President from well-known personalities in the realm of Science, Art, Literature and Social Service. Rest of 238 representatives of the States and Union Territories are elected.
- Currently, the strength of the Rajya Sabha is 245.

LOK SABHA

- The Lok Sabha whose life is five years, is the Lower House of Parliament and comprises of members directly elected by the people.
- The House of the people (Lok Sabha) at present consists of 543 directly elected members from the states and Union Territories.
- Two members of Anglo-Indian Community were nominated by the President, but by the 104th amendment of the constitution this provision have been abolished.
- The House of the People shall continue for five years (unless sooner dissolved) from the date of its meeting and no longer and the expiry of the said period of 5 years shall operate as dissolution of the House.

PARLIAMENTARY COMMITTEES

- There are several Parliamentary Committees to assist the Parliament in its deliberations.
- These are appointed or elected by the respective Houses of Lok Sabha and Rajya Sabha on a motion made or are nominated by their presiding officers.
- Among the Standing Committees, three are financial Committees:
  (*i*) Public Account Committee;
  (*ii*) Estimate Committee;
  (*iii*) Public undertaking Committee.

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Speaker of Lok Sabha

- Speaker is elected by the Lok Sabha from among its members.
- The Speaker will have the final power to maintain order within the House of the People and to interpret its rules of procedure.
- A Deputy-Speaker is also elected to officiate in absence of the Speaker.
- *G.V. Mavlankar* was the first Speaker of the Lok Sabha (1952-1956).

Supreme Court

- The Constitution provides for the Supreme Court, which consists of Chief Justice and 33 judges. They are appointed by the President of India.

QUALIFICATION AND TENURE

- Eligibility conditions for a judge of the Supreme Court are that he must be : (i) a citizen of India; (ii) a judge of a high court for a minimum period of 5 years; or (iii) an advocate of a high court for at least ten years or a distinguished jurist.
- Judges hold office till the age of 65.
- They can resign earlier or can be removed by the President on the recommendation of the two Houses of the Parliament by 2/3rd majority of the members present and voting.

Powers

- *Original jurisdiction:* Cases involving Government of India and the states or cases involving the enforcement of Fundamental Rights fall under original jurisdiction.
- *Appellate Jurisdiction:* In cases which are brought to it in the form of appeals against the judgement of the lower courts—It hears appeals in civil and criminal cases.
- *Advisory functions:* the Supreme Court advises the President on the constitutionality of a particular legal matter. However, its advice is not binding on the President.

Other Powers:

1. it is a court of record and can punish for contempt of itself;
2. it can make rules for regulating the practice and procedure of courts with the approval of the President; and
3. it can recommend to the President the removal of chairman and members of the UPSC. Supreme Court enjoys the power of judicial review (right of the court which declares as unconstitutional, the laws passed by the legislature and orders issued by executive) though it is not specifically mentioned in the Constitution.

- The first Chief Justice of India was H.J. Kania (1950-51).

COMPTROLLER AND AUDITOR GENERAL (CAG) (ARTICLE 148-151)

- The Comptroller and Auditor General of India is guardian of the public purse.
- It is his duty to see that not a *paisa* is spent out of consolidated fund of India or of a state without the authority of the appropriate legislature.
- He is appointed by President of India.
- A person with long administrative experience and knowledge of accounts is appointed.
- Holds office for 6 yrs or till 65 yrs of age.
- The President can remove him only on the recommendation of the 2 houses of Parliament (as in case of judge of Supreme Court).
- The CAG submits its reports to the President (in case of accounts relating to the Union Government) or to the State Governors (for State Government Accounts).
- The first CAG of India was *V Narahari Rao* (1948-1954).
- The CAG is not eligible for further office under the Union or State Governments. The expenses of the office of the CAG is charged to the Consolidated Fund of India.

ATTORNEY GENERAL OF INDIA

- The Attorney General of India is the first law officer of the Government of India.
- Though he is not a member of cabinet he has the right to speak in the House of Parliament, but he has no right to vote.
- The Attorney General of India shall be appointed by the President and shall hold office during his pleasure.
- His duty shall be to give advice on such legal matter from time-to-time as may be referred to him by the President.
- To be appointed as Attorney General, a candidate must be qualified to be appointed as a Judge of the Supreme Court.
- The Attorney General can participate in proceedings of the Parliament without the Right to Vote (Article 88).
- The first Attorney General of Independent India was MC Setalvad (1950-1963).

PART - VI

THE STATES (ARTICLE 152 - 237)

The Governor

- The Governor is appointed by the President and holds office during the pleasure of the President.
- Apart from the power to appoint the council of ministers, if the governor finds that the government of state cannot be carried on in accordance with the provisions of the constitution (Art. 356), he may send his report to the President who may assume to himself the functions of the government of the state. (This is popularly known as 'President's Rule').
- Article 161 gives the Governor the power to grant pardons, reprieves, remission of punishment to persons convicted under the state law.

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- Article 171 states that the States where Legislative Councils exists, the Governor can nominate some members from amongst those distinguished in literature, science, arts, cooperative movement and social service.

STATES LEGISLATURE (ARTICLE 168 - 212)

- The state legislature consists of Governor and legislative assembly.
- In some state like *Bihar, Maharashtra, Andhra Pradesh, Karnataka, Uttar Pradesh and Telangana* have a legislative council.
- The membership of the council should not be more than *one-third* of the legislative assembly but not less than 40.
- The legislative assembly of each state shall be composed of members chosen by direct election on the basis of adult suffrage and the number of members shall not be more than 500 or less than 60.
- The assembly of Sikkim, Goa, Puducherry and Mizoram have less than 60 members.

HIGH COURTS (ARTICLE 214-232)

- The High Court stands at the apex of the State Judiciary.
- As per the Constitution, there shall be a High Court in each State. But there may be a common High Court for two or more States and Union Territory, if it is provided by a law of the Parliament. For example, the Chennai High Court has its Jurisdiction over the State of Tamil Nadu and the Union Territory of Puducherry.
- The State Government has no control over it.
- There are 25 High Courts in India.
- The Calcutta High Court, established in 1862, is the oldest High Court in India.

THE PANCHAYATS (ARTICLE 243-243 O)

- Panchayati Raj was introduced in India with a view to associate the people with administration at grass-root level.
- It is a three-tier system as recommended by Balwant Rai Mehta Committee.
- Introduced by the 73rd Amendment Act, 1992 which envisaged a three tier system of local governance.

  These are:

  1. Gram Panchayat at the village level
  2. Panchayat Samiti at the block level
  3. Zila Parishad at the district level.

Jurisdiction and Seat of High Courts

Name	Year	Territorial Jurisdiction	Seat
Allahabad	1866	Uttar Pradesh	Prayagraj (Bench at Lucknow)
Bombay	1862	Maharashtra, Goa, Dadar and Nagar Haveli and Daman and Diu	Mumbai (Benches at Nagpur, Panaji and Aurangabad)
Calcutta	1862	West Bengal and Andaman & Nicobar	Kolkata (Circuit Bench at Port Blair)
Chhattisgarh	2000	Chhattisgarh	Bilaspur
Delhi	1966	Delhi	Delhi
Guwahati	1948	Assam, Nagaland, Mizoram and Arunachal Pradesh	Guwahati (Benches at Kohima, Aizawl and Itanagar)
Gujarat	1960	Gujarat	Ahmedabad
Himachal Pradesh	1971	Himachal Pradesh	Shimla
Jammu & Kashmir and Ladakh	1928	Jammu & Kashmir, Ladakh	Srinagar and Jammu
Jharkhand	2000	Jharkhand	Ranchi
Karnataka	1884	Karnataka	Bengaluru (Circuit Benches at Dharwar and Gulbarga)
Kerala	1958	Kerala & Lakshadweep	Ernakulam
Madhya Pradesh	1956	Madhya Pradesh	Jabalpur (Benches at Gwalior and Indore)
Madras	1862	Tamil Nadu & Puducherry	Chennai (Bench at Madurai)
Odisha	1948	Odisha	Cuttack
Patna	1916	Bihar	Patna
Punjab and Haryana	1966	Punjab, Haryana and Chandigarh	Chandigarh
Rajasthan	1949	Rajasthan	Jodhpur (Bench at Jaipur)
Sikkim	1975	Sikkim	Gangtok
Uttarakhand	2000	Uttarakhand	Nainital
Tripura	2013	Tripura	Agartala
Meghalaya	2013	Meghalaya	Shillong
Manipur	2013	Manipur	Imphal
Telangana	2019	Telangana	Hyderabad
Andhra Pradesh	2019	Andhra Pradesh	Amravati

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THE MUNICIPALITIES (ARTICLE 243 P-243 ZG)

- Big cities have municipal corporations headed by the elected Mayor.
- For small towns there are elected boards or councils, in turn, elect their Presidents.
- Introduced by the 74th Amendment Act, 1993 which envisages three types of urban local bodies, namely, municipality (nagar palika), city council (nagar panchayat).
- Municipal governance in India was first introduced in Madras in 1688.

PART - XIII

(ARTICLE 301 - 307)

- In this part from Article 301-307 trade, commerce and intercourse within the territory of India are given.

PART - XIV

(ARTICLE 308 - 323)

- In this part services under the union and the states are given.
- ***Article 312:*** *All India Services* and ***Article 315:*** Public Service Commissions for the Union and for the States.
- The first Public Service Commission was set up in 1926, on the recommendations of the Lee Commission.

UNION PUBLIC SERVICE COMMISSION (UPSC)

- This Commission is responsible for:
  1. recruitment to all civil services and posts, under the Union Government by written examinations, interviews and promotions, and
  2. advising the Government on all matters relating to methods of recruitment, principles to be followed in making promotions and transfers. Its Chairman is appointed by the President.

STAFF SELECTION COMMISSION (SSC)

- The Union Government has constituted a Staff Selection Commission for recruitment to non-technical Class III posts in the central government and in subordinate offices.
- The Administrative Reforms Commission had recommended the setting up of such a Commission.
- The Commission has also been entrusted with the responsibility of making recruitment to Group 'B' services like Assistants' and Stenographers Grade 'C'.
- The Commission has a chairman and two members.

ELECTIONS (ARTICLE 324-329)

- The Constitution provides for an independent election commission to ensure free and fair election to the Parliament, the State legislature and the offices of President and Vice-President.
- Consists of Chief Election Commissioner +2 Election Commissioners. They all enjoy equal powers.
- The Chief Election Commissioner and other Election Commissioners are appointed by the President.
- Election Commissioners are appointed for a term of 5 yrs.
- They are not eligible for re-appointment. Also, they cannot hold any office of profit after their retirement.
- The Election Commission was established on 25th January, 1950 under Article 324 of the Constitution.
- The first Chief Election Commissioner was *Sukumar Sen.*

Functions

- Preparation of electoral rolls and keeping voters list updated.
- Recognition of various political parties and allotment of election symbols.

NITI AAYOG

- The Indian government has replaced Planing Commission with a new institution named **NITI Aayog (National Institution for Transforming India).**
- The Niti Aayog will comprise the following:
  1. Prime Minister of India as the Chairperson.
  2. Governing Council comprising the Chief Ministers of all the States and Lt. Governors of Territories.
  3. Regional Councils will be formed to address specific issues and contingencies impacting more than one state or a region. These will be formed for a specified tenure. The Regional Councils will be convened by the Prime Minister and will comprise of the Chief Ministers of States and Lt. Governors of Territories in the region. These will be chaired by the Chairperson of the NITI Aayog or his nominee.
  4. Experts, specialists and practitioners with relevant domain knowledge as special invitees nominated by the Prime Minister.
- The full-time organizational framework will comprise of, in addition to the Prime Minister as the Chairperson:
  1. Vice-Chairperson : To be appointed by the Prime Minister.
  2. Members : Full-time. : 3
  3. Part-time members : Maximum of 2 from leading universities research organizations and other relevant institutions in an ex-officio capacity. Part time members will be on a rotational basis.
  4. Ex Officio members : Maximum of 4 members of the Council of Ministers to be nominated by the Prime Minister.
  5. Chief Executive Officer : To be appointed by the Prime Minister for a fixed tenure, in the rank of Secretary to the Government of India.
  6. Secretariat as deemed necessary.

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FINANCE COMMISSION

- The constitution of the Finance Commission is laid down in Art. 280.
- The chairman must be a person having experience in public affairs; and the other four members also having wide experience in financial matters.
- It consists of Chairman and 4 other members.
- It shall be the duty of the Finance Commission to advice the President on matters such as the distribution between the Union and States of the net proceeds of taxes that is required to be shared.
- The Finance Commission is not a permanent body. It is dissolved after it has submitted its recommendations.

Important Amendments to the Constitution

First Amendment, 1951	:	Added Ninth Schedule.
Twenty-second Amendment, 1969	:	Formation of Meghalaya within the state of Assam was facilitated.
Twenty-sixth Amendment, 1971	:	The privy and privileges of the former rulers of Indian States were abolished.
Thirty-first Amendment, 1973	:	The upper limit of representation of states was raised from 500 to 525. The upper limit for representation of the UTs was reduced from 25 to 20.
Thirty-sixth Amendment, 1975	:	Sikkim was made a full-fledged state of Indian Union and it was included in the First Schedule.
Thirty-eight Amendment, 1975	:	This act led to the amendment of Article 123, Article 213 and Article 352 which stated that the satisfaction of President or of Governor contained in these Articles would be called in question in any court of law.
Forty-second Amendment, 1976	:	This amendment was done in accordance with the recommendations of Swaran Singh Committee and included a number of amendments.
Forty-third Amendment, 1977	:	It provided for the restoration of the Jurisdiction of the Supreme Court and High Courts, curtailed by the enactment of the Constitution (Forty-Second Amendment) Act, 1976.
Forty-fourth Amendment, 1978	:	The right to property was deleted as Fundamental Right and was made a legal right.
Fifty-third Amendment, 1986	:	The Act grants statehood to the Union Territory of Mizoram, thus making it the 23rd State of the Indian Unions.
Fifty-sixth Amendment, 1987	:	The UT of Goa converted into Goa state through this amendment whereas Daman and Diu were organised under a new UT.
Seventy-third Amendment, 1992	:	It is concerning Panchayati Raj.
Seventy-fourth Amendment, 1992	:	It is regarding Municipal Boards and Corporations.
Eighty-ninth Amendment, 2003	:	It provides for constitution of a separate National Commission for Scheduled Tribes. (Earlier, there was a combined National Commission for both SC/STs).
Ninety-first Amendment, 2003	:	It is regarding restricting the total number of Ministers including Prime Minister/ Chief Minister in Lok Sabha and State Legislatures to 15% of the total number of the Union or State Legislatures.
Ninety-sixth Amendment, 2011	:	Amendment of 8th Schedule, it replaces 'Orissa' with 'Odisha'.
Ninety-eight Amendment, 2013	:	(Insert Article 371 J) To empower the Governor of Karnataka to take steps to develop Hydrabad Karnataka Region.
Ninety-ninth Amendment, 2015	:	The amendment is in toto quashed by Supreme Court on 16 October, 2015.
One hundredth Amendment, 2015	:	Exchange of certain enclave territories with Bangladesh and conferment of citizenship rights to residents of enclaves consequent to signing of Land Boundary Agreement (LBA) Treaty between India and Bangladesh.
One hundredth and first Amendment, 2016	:	The act amends the Constitution to introduce "The Goods and Services Tax (GST)."
One hundredth and Third Amendment, 2019	:	The Act providing 10 per cent reservation in government jobs and educational institutions to Economically Weaker Sections (EWS) of General Category, came into effect on January 14, 2019.
One hundredth and Fourth Amendment, 2019	:	It extends the reservation of seats for members from SC and ST in Lok Sabha and State Legislative Assemblies.

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NATIONAL SYMBOLS

NATIONAL EMBLEM

- State emblem of India is an adaptation from the Sarnath Lion Capital of Ashoka. It was adopted by the Government of India on January 26, 1950. In the adapted form, only three lions are visible, the fourth being hidden from the view.
- The wheel (Dharma Chakra) appears in relief in the centre of the abacus with a bull on the right and a horse on the left.
- The bell-shaped lotus has been omitted. The words ''Satyameva Jayate'' meaning ''Truth alone triumphs'' are inscribed below the Emblem in Devanagari script.

NATIONAL FLAG

- The National Flag of India is a horizontal tricolour of deep saffron (Kesari), white and dark green in equal proportion.
- In the centre of the white band there is a wheel in navy blue colour. It has 24 spokes.
- The ratio of the length and the breadth of the flag is 3 : 2. Its design was adopted by the Constituent Assembly of India on July 22, 1947.

NATIONAL ANTHEM

- Rabindranath Tagore's song 'Jana-gana-mana' was adopted by the Constituent Assembly as the National Anthem of India on January 24, 1950.

Jana-gana-mana-adhinayaka jaya he,
Bharata-bhagya-vidhata
Punjab-Sindh-Gujarat-Maratha-
Dravida-Utkala-Banga
Vindhya-Himachala-Yamuna-Ganga
Uchhala-jaladhi-taranga.
Tava subha name jage,
Tava subha asisa mange,
Gahe tava jaya gatha,
Jana-gana-mangala-dayak,
jaya he Bharata bhagya vidhata,
Jaya he, jaya he, jaya he,
Jaya jaya jaya, jaya he.

NATIONAL SONG

- Bankim Chandra Chatterji's 'Vande Mataram' which was a source of inspiration to the people in their struggle for freedom, has been adopted as National Song. It has an equal status with the National Anthem.

Vande Mataram
Sujalam, suphalam, malayaja-shitalam,
Shasya shyamalam, Mataram
Shubhrajyotsna, pulkita yaminim,
Phulla kusumita drumadalashobhinim,
Subhasinim sumadhura—bhashinim,
Sukhadam, Varadam, Mataram.

- **National Bird and Animal of India:** Peacock and Tiger.
- **National Aquatic Animal:** Dolphin
- **National Flower:** Lotus
- **National Calendar:** It was adopted on March 22, 1957. It has 365 days in the year and the first month of the year is Chaitra.

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GENERAL SCIENCE

PHYSICS

PHYSICAL QUANTITIES

- Physical quantities may be divided in two classes:
  1. Scalar Quantities 2. Vector Quantities
- A scalar quantity is one which has only magnitude.
- A vector quantity has both magnitude and direction.
- Force, Velocity, Momentum, Acceleration are examples of vector quantities.
- Mass, length, time, volume, speed, energy, work are examples of scalar quantities.

UNITS

- All measurements in physics require standard units.
- In 1960, the General Conference of Weights and Measures recommended that a metric system of measurements called the International System of Units, abbreviated as SI units, be used.

Some Important Units

S.No.	Units	Quantity
1.	Metre	Length
2.	Kilogram	Mass
3.	Second	Time
4.	Ampere	Electric Current
5.	Candela	Luminous Intensity
6.	Newton	Force
7.	Joule	Workdone
8.	Watt	Power
9.	Coulomb	Electric Charge
10.	Volt	Potential Difference
11.	Ohm	Electrical Resistance
12.	Farad	Capacitance
13.	Henry	Inductance
14.	Lumen	Luminous Flux

- Very small distances are measured in micro-meters or (microns) (μm), angstroms (Å), nanometers (nm) and femtometres (fm).

MOTION

- When a body changes its position with respect to something else as time goes on, we say the body is in motion.
- There are two types of motion—translational (linear) and rotational (spin).
- The motion of a car on a road is translational whereas the motion of a top, spinning on its axis is rotational.

SPEED

- It is a scalar form of velocity and is defined as the distance travelled in one second.
- $\text{Speed} = \dfrac{\text{distance travelled}}{\text{time required}}$
- SI unit of speed is m/s.

VELOCITY

- The distance covered by an object in a specified direction in unit time interval is called velocity.
- The SI unit of velocity is m/s.
- Velocity is a vector quantity.

ACCELERATION

- The velocity of a body changes due to change in its speed or direction or both. The rate of change of the velocity of a body is called its acceleration.
- $\text{Acceleration} = \dfrac{\text{change in velocity}}{\text{time taken}}$

FORCE AND MOTION

GRAVITATIONAL FORCE

- It is the force of attraction between two masses.
- It is gravitational force that holds the moon in its orbit round the earth and the earth in its orbit round the sun.
- *Newton's Law of Universal Gravitation* states that every particle in the universe attracts every other particle with a force that is directly proportional to the product of their masses and inversely proportional to the square of the distance between them.
- The value of G is 6.67×10^{-11} SI units.

CENTRIPETAL FORCE

- The force acting towards the centre on a particle executing uniform circular motion is called centripetal force and is given by

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$$F = \frac{mv^2}{r}$$

where, m = Mass of the object

v = Speed

r = Radius of the Circular Path

- In case of the moon, gravitational force between the earth and the moon acts as the centripetal force.
- Centripetal force always acts on the particle performing circular motion.

CENTRIFUGAL FORCE

- The pseudo force that balances the centripetal force in uniform circular motion is called centrifugal force.
- Centrifugal force is directed away from the centre along the radius.
- The centrifugal force is zero exactly at the poles and maximum at the equator.

WEIGHT

- The weight of a body is the force with which the earth attracts the body towards its centre.
- The mass of a body is a constant quantity whereas its weight varies slightly from place-to-place on the earth.
- The weight of a body is maximum at the poles and minimum at the equator. This variation in weight is due to:

  1. the shape of the earth.
  2. the rotation of the earth about its axis.
- The weight of an object is less at high elevations than at sea level.
- At the centre of the earth, the weight of a body would be zero.
- On the surface of the moon the value of the acceleration due to gravity is nearly one-sixth of that on earth and, therefore, an object on the moon would weigh only one-sixth its weight on the earth. The mass of an object on the moon would be the same as on earth.
- The weight of a body would be more if the earth stopped rotating. Conversely, if the speed of rotation were higher, the weight would be less.
- A person weighs more in a lift, which is accelerating upward.
- An astronaut feels weightless in a spaceship because he is not pushing against anything.

FRICTION

- Friction is the force which opposes the relative motion of two surfaces in contact.
- It is friction between the ground and the soles of our shoes that makes walking possible and it is lack of friction that makes our feet slip on highly polished surfaces.
- Friction in machines wastes energy and also causes wear and tear. This friction is reduced by using (1) lubricants, and (2) ball bearings.

NEWTON'S LAWS OF MOTION

First Law

- Every object continues in its state of rest or of uniform motion in a straight line if no net force acts upon it. It is also known as *law of inertia*.
- **Examples:** 1. An unwary passenger in a fast-moving bus falls forward when it stops suddenly. This happens because the feet of the passenger come to rest suddenly whereas his upper part of body continues to be in motion. 2. A person getting down from a moving bus has to run some distance, in the direction of the bus, before stopping. If he does not run he is bound to fall because his feet come to rest whereas his body continues to be in motion.

Momentum

- The momentum of a body is defined as the product of its mass and velocity.

Second Law

- This law states that "the rate of change of momentum of a body is proportional to the applied force and takes place in the direction of the force."
- If we express force (F) in Newtons, mass (m) in kilograms and acceleration (a) in metres per second squared, we can write the second law as; F = ma.
- In travelling the same distance, a car consumes more fuel on a crowded road than on a free road. This happens because the car has to stop and start quite often on a crowded road. The repeated acceleration requires a force (second law), which ultimately comes from the fuel. On a free road the car runs at almost uniform speed requiring fewer accelerations and hence less fuel consumption.

Third Law

- This law states that "to every action there is an equal and opposite reaction."
- When a bullet is fired from a gun, equal and opposite forces are exerted on the bullet and the gun.
- The engine in a jet aeroplane works on the same principle as a rocket but there is a difference in the method of obtaining the high velocity as jet.

IMPULSE

- If a force acts on a body for a very short time, then the product of force and time is called the impulse.

  Impulse= Change in momentum

  = Force × Time

Application of Impulse

1. A cricket player draws his hand back while catching.
2. A person jumping on hard cement floor receives more injuries than a person jumping on muddy or sandy floor.

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WORK, POWER AND ENERGY

WORK

- Whenever a force acting on a body displaces it, work is said to be done.

  Work = Force × Distance moved in the direction of force.
- Work is a scalar quantity and its SI unit is Joule (J).

POWER

- Power is defined as the rate of doing work.

$$\text{Power} = \frac{\text{Work done}}{\text{Time taken}}$$

- The SI unit of power is Watt (W) and is also measured in horse power.

  1 HP = 746 W

ENERGY

- Energy is defined as the capacity to do work.

Kinetic Energy

- The energy possessed by an object due to its motion is called kinetic energy and is described by the expression

$$\text{KE} = \frac{1}{2}mv^2$$; where, m = mass of the object

v = speed

Potential Energy

- Potential energy is the energy possessed by the body by virtue of its position, configuration or any condition of stress or strain.
- There are many examples of potential energy. A stone held at some height above the ground has potential energy. Water in an elevated reservoir possesses potential energy.

Transformation of Energy

S.No.	Equipment	Transformation
1.	Dynamo	Mechanical energy into electrical energy
2.	Microphone	Sound energy into electrical energy
3.	Loud Speaker	Electrical energy into sound energy
4.	Electric Bulb	Electrical energy into light and heat energy
5.	Battery	Chemical energy into electrical energy
6.	Electrical Motor	Electrical energy into mechanical energy

CENTRE OF GRAVITY

- The centre of gravity of a body is the point where the whole weight of the body can be considered to act.
- Racing cars are build low and with wide wheel bases to reduce the risk of overturning at sharp bends.
- While crossing a river in a boat, passengers are not allowed to stand. This keeps the CG of the system (boat and passengers) low and ensures stability.

ARTIFICIAL SATELLITES

- In the case of a satellite, the centripetal force is provided by the gravitational pull of the earth.
- If the speed of a satellite is more than 11.2 km/s or 25,000 miles/hour, the satellite would escape the earth entirely and would never come back. This is called escape velocity.
- The existence of gaseous atmosphere on the earth is due to the high value of its escape velocity.

Geostationary Satellites

- Geostationary satellites are stationary with respect to an observer on the earth. Their time period is 24-hour. There height above the surface of earth is 36,000 km. They are always in equatorial plane and their orbits are circular. They are also called parking orbits.

DENSITY AND RELATIVE DENSITY

DENSITY

- The mass per unit volume of a substance is called its density.

$$\text{Density} = \frac{\text{Mass}}{\text{Volume}}$$

- The SI unit of density is kilogram per metre cubed (kg/m^3).
- The relative density of a substance is the ratio of the density of the substance to the density of water.
- Relative density has no unit.

PRESSURE

- Pressure is defined as force acting per unit area.

$$\text{Pressure} = \frac{\text{Force}}{\text{Area}}$$

- The SI unit of pressure is newton per metre squared or pascal.
- Broad wooden sleepers are placed below the rails to reduce the pressure exerted by the weight of a train.
- The pressure of water increases with depth, therefore bottom of a dam is made much thicken than the top.
- The pressure exerted on an enclosed liquid at one place is transmitted equally throughout the liquid. This is called Pascal's Principle.
- Hydraulic presses, hydraulic brakes, hydraulic door closers, etc. are applications of the Pascal's Principle.
- At high attitudes where atmosphere pressure is less nose bleeding may occur due to the greater pressure of blood.

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- In an aircraft flying at high altitude, normal atmospheric pressure is maintained by the use of air pumps. If this were not done, the crew and passengers would experience difficulty in breathing and consequently face dangers.
- Atmospheric pressure is measured with an instrument called the *Barometer*.

ARCHIMEDE'S PRINCIPLE

- This principle states that when a body is wholly or partially immersed in a fluid, it experiences an upthrust (upward force) equal to the weight of the fluid displaced.
- An iron nail sinks in water whereas a ship made of iron and steel floats. This is due to the fact that a ship is hollow and contains air and, therefore, its density is less than that of water.
- The density of sea water is more than that of river water, due to this a ship sinks less in sea water. It is for this reason that a ship rises a little when it enters a sea from a river.
- It is because of the higher density of sea water that it is easier to swim in the sea.
- A balloon filled with a light gas, such as hydrogen, rises because the average density of the balloon and the gas is less than that of air. The balloon cannot rise indefinitely because the density of the air decreases with increasing altitude. At a certain height, where the density of air is equal to the average density of the balloon, it ceases to rise and drifts sideways with the wind.
- When an ice block floats in water the water level will remain the same when all the ice melts into water.
- A *hydrometer* is an instrument used for measuring the relative density of liquids.
- A special type of a hydrometer called *Lactometer* is used for testing milk by measuring its density.

SURFACE TENSION

- Surface tension is that property of liquids owing to which they tend to acquire minimum surface area.
- Surface tension is caused by molecular attractions.
- When a paint brush is dipped in water all its hair spread out but when it is taken out it is covered with a thin film of water which contracts due to surface tension and pulls the hair together.
- Liquid drops, such as raindrops, oildrops, drops of molten metals, dewdrops etc. are all spherical because their surface tend to contract in order to have minimum surface area. For a given volume, a sphere has the minimum surface area.
- Soaps and detergents lower the surface tension of water. This increases the wetting power of water or its ability to detach dirt particles from clothes and untensils.
- The force of attraction between unlike molecules is called **adhesion** and that between like molecules **cohesion.**
- The melted wax of a candle is drawn up into the wick by capillary action. Oil rises up a lamp wick for the same reason.
- If one end of a sugar cube is dipped into tea, the entire cube is quickly wet on account of capillary action.

VISCOSITY

- The force which opposes the relative motion between different layers of liquid or gases is called viscous force.
- Viscosity is the property of liquids and gases both.

BERNOULLI'S THEOREM

- According to Bernoulli's theorem, in case of streamline flow of incompressible and non-viscous fluid (ideal fluid) through a tube, total energy (sum of pressure energy, potential energy and kinetic energy) per unit volume of fluid is same at all points.

1. When a bowler spins a ball, it changes its direction (swings) in the air due to unequal pressure acting on it.

HEAT

- Heat is that form of energy which flows from one body to other body due to difference in temperature between the bodies. The amount of heat contained in a body depends upon the mass of the body.

TEMPERATURE

- The temperature of a body is the quantity that tells how hot or cold it is with respect to some standard body.

MEASUREMENT OF TEMPERATURE

- Temperature is measured by a thermometer.
- A thermometer may be graduated in following scales—
  1. The upper and lower points of centigrade scale are 100°C and 0°C.
  2. The upper and lower points of Fahrenheit scale are 212°F and 32°F.
  3. The upper and lower points of Reaumur scale are 80°R and 0°R.
  4. The upper and lower points of Kelvin scale are 373K and 273K.
  5. The upper and lower points of Rankine scale are 672° Ra and 460° Ra.
- At –40 degrees both celsius and Fahrenheit scales will show identical readings.
- Water cannot be used in a thermometer becaues it freezes at 0°C and also because of its irregular expansion.

THERMAL EXPANSION

- Solids, liquids and gases generally expand when heated and contract when cooled.
- Gaps have to be left in railway tracks to make allowance for expansion, otherwise the rails will buckle. Allowance

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is made for the expansion of long steel bridges. One end of such bridge is fixed while the other rests on rollers.

- Telephone wires sag more in summer than in winter due to thermal expansion.

EXPANSION OF WATER

- Water has its minimum volume and maximum density at 4°C.

TRANSMISSION OF HEAT

- There are three ways of heat transmission: 1. Conduction; 2. Convection; 3. Radiation.

Conduction

- In this process, heat is transferred from one place to other place by the successive vibration of the particles of the medium without bodily movement of the particles of the medium.
- Conduction takes place mainly in solids.
- Air is a very bad conductor of heat. The good insulating properties of wool, cotton, etc. are mainly due to the air spaces they contain.

Convection

- In this process, heat is transferred by the actual movement of particles of the medium from one place to other place.
- In liquids and gases heat is transmitted by convection.

Radiation

- In this mode of heat transmission heat is transferred from one place to another without effecting the intervening medium.

HEAT CAPACITY

- The heat capacity of a body is defined as the heat required to raise the temperature of the body by 1K. Its SI unit is J/K.

SPECIFIC HEAT CAPACITY

- The specific heat capacity of a substance is the heat required to raise the temperature of a unit mass of the substance by 1K.
- Its SI unit is J/kg K.
- It is because of its high specific heat capacity that water is used as a cooling liquid in car engine.

LATENT HEAT

- It is defined as the amount of heat absorbed or given out by a body during the change of state.
- Each gram of ice that melts absorbs 336 J of heat.

EVAPORATION

- Water can change into the vapour state either by boiling or by evaporation at lower temperatures.
- When sweat evaporates from the skin it draws much heat from the body and produces a cooling sensation.
- In summer, water is stored in pitchers for cooling. Water oozes out of the pores of the pitchers and cools on evaporation.
- The rate of evaporation increases with increase in temperature.

REFRIGERATOR

- In a refrigerator, cooling is produced by the evaporation of a volatile liquid, freon, inside a copper coil (evaporator), which surrounds the freezer.
- The cooling unit (freezer) in a refrigerator is fitted near the top to cool the whole of the interior.

RELATIVE HUMIDITY

- Relative humidity is defined as the ratio of the mass of water vapour in a given volume of air to the mass required for saturating the same volume of air at the same temperature.
- Relative humidity is measured with an instrument called the hygrometer.

PRESSURE COOKER

- The boiling point of a liquid depends on external pressure.
- When the atmospheric pressure is 76 cm of mercury, water boils at 100°C. But when the pressure is increased, the boiling point of water is raised.
- In a pressure cooker, water boils at temperatures higher than 100°C due to increased pressure. The increased boiling temperature allows water to hold more heat which cooks food faster.
- At higher altitudes, atmospheric pressure is reduced. This lowers the boiling point of water and food takes much longer to cook.

WAVE MOTION

- Wave motion may be defined as the transfer of energy without the net transfer of matter.
- If the particles of the medium vibrate perpendicular to the direction of propagation of wave, the wave is called transverse wave.
- Light waves are transverse waves.
- If the particles of the medium vibrate in the direction of propagation of wave, the wave is called longitudinal wave.
- Sound waves are longitudinal waves.

ELECTROMAGNETIC WAVE

- Electromagnetic waves include an enormous range of frequencies—from radio waves with frequencies less than 10^5 Hz to gamma rays having frequencies greater than 10^{20} Hz.

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- All electromagnetic wave have the same speed (3×10^8 m/s) in vacuum. The relation $v = n\lambda$ holds good for all electromagnetic waves.

RADIO AND TELEVISION TRANSMISSION

- Radio waves sent out by radio stations are reflected by the ionosphere and can be received anywhere on the earth.
- At night the radio reception improves because the layers of the ionosphere are not exposed to sunlight and are more settled.
- Radar (Radio detection and ranging) employs high frequency radio waves for detecting objects like ships and aeroplanes.
- In microwave oven, when the waves fall on the food, these are absorbed by water, fats, sugars and certain other molecules whose consequent vibrations produce heat. Since heating occurs inside the food, without warming the surrounding air, the cooking time is greatly reduced.
- In microwave oven, food cannot be cooked in metal vessels because the metal blocks out the microwaves.

LIGHT

- Light is a form of energy which is propagated as electromagnetic waves.
- Light is a transverse wave.
- Speed of light in vacuum is 3×10^8 m/s.
- Light takes 8 minute 16.6 second to reach from sun to earth.

REFLECTION

- When light is incident upon a surface, part of it is reflected. But certain surfaces like mirrors and polished metals reflect almost all the light incident upon them.
- The law of reflection states that the angle of incidence is equal to the angle of reflection.
- To see full image in a plane mirror, a person requires a mirror of at least half of his height.

INCLINED MIRROR (NO. OF IMAGES)

- When an object is placed between two inclined mirrors, several images of the object are formed.

CURVED MIRRORS

- There are two types of curved spherical mirrors—1. Concave Mirror, 2. Convex Mirror.
- Concave mirror can concentrate the sun's radiation falling on it at one point, it can be used as a burning glass.
- Concave mirrors are also used in solar cookers.
- Large concave mirrors are used in reflecting telescopes for observing and photographing distant stars and other heavenly bodies.
- Concave mirror is also used as a shaving or make-up mirror.
- Small concave mirrors are used by dentists for examining teeth.
- Concave parabolic mirrors are used in searchlight and headlamps of cars.
- Convex mirrors are also used as rear view mirrors in vehicles.

REFRACTION

- When a ray of light passes from one medium to other it suffers a change in direction at the boundary of separation of two media. This phenomenon is called refraction.
- When a ray passes from one medium to another optically denser medium, e.g., from air to water or glass, it bends towards the normal. Conversely, a ray passing from water or glass into air is bent away from the normal.
- Rivers appear shallow, coin in a beaker filled with water appears raised, due to refraction.
- Another effect of refraction is the apparent upward bending of the immersed portion of a stick when dipped in water.
- It is due to refraction, produced by the earth's atmosphere, that the sun is visible for several minutes after it has set below the horizon. Thus, atmospheric refraction tends to lengthen the day.
- When the sun (or moon) is near the horizon, it appears elliptical, i.e., with the vertical diameter less than the horizontal diameter. This happens because rays from the lower edge of the sun are bent more than those from the upper edge (Atmospheric Refraction).
- One of the most interesting effects of atmospheric refraction and Mirage is a combined effect of atmospheric refraction and total internal reflection.

DISPERSION

- White light consists of seven colours—violet, indigo, blue, green, yellow, orange and red. These colours are called the spectrum of the white light.
- Violet has the minimum wavelength (or maximum frequency) and red the maximum wavelength (or minimum frequency).
- Due to different speeds, the colours are refracted through different angles and therefore, when a narrow beam of white light passes through a glass prism, it is split up into its constituent colours. This separation of light into colours is called dispersion.

COLOUR OF OBJECTS

- We see objects because of the light they reflect.
- When a rose is viewed in white light, its petals appear red and the leaves appear green, because the petals reflect the red part of the white light and leaves reflect the green part. The remaining colours are absorbed. When the same rose is viewed in green light, the petals will appear black

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and the leaves green. In blue or yellow light both the petals and leaves will appear black.

- Red, blue and green are primary colours.

LENSES

- There are mainly two types of lenses:
  1. Convex or Converging Lens
  2. Concave or Diverging Lens
- Converging or convex lens is used as a magnifying glass.
- Power of a lens is its capacity to deviate a ray. Power of a lens is measured as the reciprocal of the focal length.

$$P = \frac{1}{f}$$

- SI unit of power of lens is dioptre (D).
- The power of a converging lens is positive and that of a diverging lens is negative.
- For all positions of the object, the images formed by diverging (concave) lens are virtual, erect and diminished.

EYE

- The light entering the eye is focused by the eye-lens to form an image on the retina.
- In front of the eye, lens is the coloured part of eye, called the iris, which automatically adjusts the size of the pupil to the intensity of light falling on it.
- In bright light the iris automatically shuts tighter, reducing the amount of light entering the pupil. This protects the retina from getting damaged.
- When a person enters a dark room after being in bright light, he is not able to see clearly for a while because the iris is unable to dilate the pupil immediately.
- Least distance of distinct vision is 25 cm.

DEFECTS OF VISION

- A person suffering from long sight (hyper-metropia) can clearly see objects at infinity but cannot see near objects clearly. This defect is caused by the eyeball being too short and can be corrected by wearing converging lenses.
- In the case of a person suffering from short sight (myopia), the eye ball is too long and distant objects are focused in front of the retina. This defect can be corrected by wearing diverging lenses.
- ***Astigmatism:*** Curvature of cornea becomes irregular and image is not clear. Cylindrical lens is used.

SCATTERING OF LIGHT

- When light falls on atoms and molecules, it is scattered in all directions.
- Scattering of light is maximum for violet colour and minimum for red colour.
- Blue colour of sky is due to scattering of light.
- In the evening, the sun is lower in the sky and its light has to traverse a longer path through the atmosphere to reach an observer. Thus, at sunset, blue, green and other colours having been scattered only red and some orange light reach us and the sun appears a deep orange-red.
- In outerspace, *i.e.,* beyond the atmosphere, there is nothing to scatter the sunlight and therefore the sky appears dark and stars are visible even in the presence of the sun.

INTERFERENCE OF LIGHT

- The superposition of two (or more) waves of the same kind that pass the same point in space at the same time is called interference.
- Beautiful colours seen in soap bubbles and oil films on water are produced due to the interference of white light reflected by these surfaces.
- LASER (Light Amplification by Stimulated Emission of Radiation) is an optical device which produces an intense beam of coherent monochromatic light.
- Examples of Interference of Light: Holography, Laser.

DIFFRACTION OF LIGHT

- When a beam of light passes through a narrow slit or an aperture, it spreads out to a certain extent into the region of geometrical shadow. This is an example of diffraction, *i.e.,* of the failure of light to travel in a straight line.

SOUND

- Sound waves are longitudinal and cannot travel in vacuum. The transmission of sound requires a medium : air, liquid or solid.
- The longitudinal mechanical waves which lie in the frequency range 20 Hz to 20,000 Hz are called audible or sound waves. These waves are sensitive to human ear.
- The longitudinal mechanical waves having frequencies less than 20 Hz are called Infrasonic. These waves are produced by sources of bigger size such as earthquakes, volcanic eruptions, ocean waves etc.
- The longitudinal waves having frequencies greater than 20,000 Hz are called ultrasonic waves. Human ear cannot detect these waves. But some animals such as cats, dogs, bats can detect these waves.

PITCH

- The pitch (shrillness of a sound) depends on its frequency.
- A sound of higher frequency has a higher pitch.
- The pitch of a woman's voice is higher than that of a man.

LOUDNESS

- The relative loudness of a sound is measured in decibels (db).
- All stringed instruments, such as the violin, sitar, guitar, etc. have sound boxes attached to increase the loudness.

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SPEED OF SOUND

- The presence of water vapour in the air increases the speed of sound.
- Sound travels faster through warm air than through cold air. The speed of sound is higher on a hot day than on a cold day.
- Thunder is heard much after the flash of lightning is seen because of the wide difference in the speeds of light and sound.

REFLECTION OF SOUND

- When a sound wave is reflected by a distant obstacle, such as a wall or a cliff, an echo is heard.
- To hear echo, the minimum distance between the observer and reflector should be 17 m.
- Exploration of underwater gas and oil is done by detecting the echoes of shock waves produced by explosions on the water surface.
- Bats emit ultrasonic waves of frequencies up to 80,000 Hz and use the reflection of these waves (echoes) to determine the presence and distance of objects on their way and from them respectively.

DOPPLER EFFECT

- The Doppler effect is the change in frequency of a wave (sound or light) due to the motion of the source or observer.
- It is due to the Doppler effect that the whistle of a train appears shriller when it approaches a listener than when it moves away from him.

ELECTRICITY

- Electricity produced by friction between two dissimilar objects is known as static electricity. Depending on the nature of the objects, one acquires a positive charge and the other an equal negative charge. For example, if a glass rod is rubbed with silk, the rod acquires positive charge and the silk an equal negative charge.
- *Lightning* is a gigantic electric discharge occurring between two charged clouds or between a charged cloud and the earth.

CONDUCTOR

- Conductors are those materials which allow electricity (charge) to pass through themselves.
- Metals conduct electricity because they have a large number of conduction or free electrons.

INSULATORS

- Insulators are those materials which do not allow electricity to flow through themselves. Insulators have no free electrons.

SUPER CONDUCTORS

- The resistance of metals to flow of electricity reduces with decreasing temperature. At temperatures near absolute zero, metals have almost zero resistance and became super conductors.

SEMI-CONDUCTORS

- Certain materials, such as silicon and germanium, have electrical resistivity intermediate between those of conductors and insulators. These materials are termed as semi-conductors.
- Semi-conductors are good insulators in their pure crystalline form but their conductivity increases when small amounts of impurities are added to them.

ELECTRIC CURRENT

- Electric current is simply the flow of electric charge. In solid conductors the flow of electrons and in fluids the flow of ions as well as electrons constitute the current.
- SI units of electric current is Ampere (A).

ELECTRICAL RESISTANCE

- When electric current flows through a conductor, e.g., a metallic wire, it offers some obstruction to the current. This obstruction offered by the wire is called its electrical resistance.
- SI unit of Resistance is ohm.

OHM'S LAW

- If physical conditions like temperature, intensity of light etc. remains unchanged then electric current flowing through a conductor is directly proportional to the potential difference across its ends.

ELECTRIC MOTOR

- In an electric motor, electrical energy is converted into mechanical energy.
- Electric fans, mixers, washing machines, etc. work on electric motors.

INVERTER

- An inverter is a device which converts DC to AC. The inverters used in homes and offices are specially designed to:
  1. Convert DC from a battery to AC, and
  2. Charge the battery.

FUSE

- Electric fuse is a protective device used in series with an electric appliance to save it from being damaged due to high current.
- A fuse is a short piece of wire made of a tin-lead alloy, which has a low melting point.
- Fuses are always connected in the live wire in series.

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COST OF ELECTRICITY

- The consumption of electrical energy in a house is measured in the unit kWh.
- Kilowatt hour is equal to the energy consumed in the circuit at the rate of 1 kilowatt for 1 hour.

MAGNETISM

- A magnet attracts and holds pieces of iron but does not attract pieces of copper.
- Iron, cobalt, nickel and certain alloys are strongly magnetic whereas copper, wood, glass, etc. are non-magnetic.
- Our earth behaves as a powerful magnet whose south pole is near the geographical north pole and whose north pole is near the geographical south pole.

ATOMIC & NUCLEAR PHYSICS

- Atom consists of three fundamental particles electron, proton and neutron. All the protons and neutrons are present in the central core of atom called nucleus. Electrons revolve around the nucleus.
- The total number of protons in the nucleus is called atomic number (Z).
- The total number of proton and neutrons in the nucleus is called mass number (A).
- Ernest Rutherford, discovered nucleus by the scattering of α-particles from gold foil.

RADIOACTIVITY

- Henry Bacquerel (1896) observed that a photographic plate blackened, when placed near double sulphate of potassium and uranium. He further observed that uranium emitted special kind of rays. They were called Becqueral rays.
- Pierre and Marie Curie observed that the radiation from pitchblende was four times stronger than uranium. In 1898, they finally discovered two new substances—Polonium and Radium. These newly discovered substances were called radioactive substances and this property of these substances was named radioactivity.
- No radioactive substance emits both α and β particles simultaneously.

X-RAYS

- X-rays are electromagnetic radiations having wavelength from a fraction of an Angestrom to about 100Å. They were discovered by Rontgen during his studies on the electrical discharge phenomena in gases—he found that an unknown radiation was produced when electrons collided with the walls of the tubes.

ATOMIC ENERGY

- India today ranks sixth in the atomic energy programmes. It has developed the required know-how and expertise to manufacture nuclear weapons, but it believes in the peaceful uses of atomic power. The Atomic Energy Commission was set-up in the country in 1948 under the Chairmanship of Dr. H. J. Bhabha.
- ***Bhabha Atomic Research Centre (BARC):*** The Bhabha Atomic Research Centre at Trombay near Mumbai (Maharashtra) has four research reactors: (*i*) APSARA—It is the first atomic reactor in Asia; (*ii*) CIRUS—It is a joint Indo-Canadian project; (*iii*) PURNIMA II—a zero energy fast reactor, and (*iv*) DHRUVA—a high power completely indigenous nuclear research reactor with most advanced laboratories in the world. Another fast breeder reactor KAMINI at Kalpakkam has been constructed. Today India is the seventh country in the world and the first developing nation to have mastered the fast breeder reactor technology.
- **Nuclear Power:** Under Nuclear Power Corporation of India Limited (NPCIL) there are seven nuclear power stations in operation in six States:
  (*i*) Tarapur—Maharashtra, (*ii*) Rawatbhata —Rajasthan, (*iii*) Kalpakkam—Tamil Nadu, (*iv*) Narora—U.P., (*v*) Kakrapara—Gujarat, (*vi*) Kaiga—Karnataka and (*vii*) Kudankulam—Tamil Nadu.
- **Heavy Water:** Heavy water is one of the essential input for Pressurised Heavy Water Reactors (PHWRs) used both as a coolant and moderator. The first heavy water plant was set-up in 1962 in Nangal. Subsequently 7 more plants have been set-up at (*i*) Baroda, (*ii*) Tuticorin, (*iii*) Kota, (*iv*) Talcher, (*v*) Thal, (*vi*) Hazira and (*vii*) Manuguru.
- **Research and Development Centres:** Four research centres namely (*i*) Bhabha Atomic Research Centre, Trombay (Maharashtra), (*ii*) Indira Gandhi Centre for Atomic Research, Kalpakkam (Tamil Nadu), (*iii*) Centre for Advanced Technology, Indore (Madhya Pradesh), (*iv*) Variable Energy Cyclotron Centre at Kolkata (West Bengal) are focal points of research and development work in nuclear energy and related discipline.
- **India's Nuclear Explosions:** On May 18, 1974 India conducted her first underground nuclear explosion at Pokhran (Rajasthan) in the Thar desert, 20 km. away from Jaisalmer, at a depth of more than 100 metres. The successful explosion made India the sixth nuclear nation in the world.
- India conducted 5 nuclear explosion tests at Pokhran in two phases on May 11 and May 13, 1998 and became a nuclear power state.

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IMPORTANT INVENTIONS

Name of Invention	*Inventor*	*Nationality*	*Year*
Aeroplane	Orville & Wilbur Wright	U.S.A.	1903
Ball-Point Pen	John J. Loud	U.S.A.	1888
Barometer	Evangelista Torricelli	Italy	1644
Bicycle	Kirkpatrick Macmillan	Britain	1839-40
Bifocal Lens	Benjamin Franklin	U.S.A.	1780
Car (Petrol)	Karl Benz	Germany	1888
Celluloid	Alexander Parkes	Britain	1861
Cinema	Nicolas & Jean Lumiere	France	1895
Clock (mechanical)	I-Hsing & Liang Ling-Tsan	China	1725
Diesel Engine	Rudolf Diesel	Germany	1895
Dynamo	Hypolite Pixii	France	1832
Electric Lamp	Thomas Alva Edison	U.S.A.	1879
Electric Motor (DC)	Zenobe Gramme	Belgium	1873
Electric Motor (AC)	Nikola Tesla	U.S.A.	1888
Electro-magnet	William Sturgeon	Britain	1824
Electronic Computer	Dr. Alan M. Turing	Britain	1943
Film (moving outlines)	Louis Prince	France	1885
Film (musical sound)	Dr. Le de Forest	U.S.A.	1923
Fountain Pen	Lewis E. Waterman	U.S.A.	1884
Gramophone	Thomas Alva Edison	U.S.A.	1878
Helicopter	Etienne Oehmichen	France	1924
Jet Engine	Sir Frank Whittle	Britain	1937
Laser	Charles H. Townes	U.S.A.	1960
Lift (Mechanical)	Elisha G. Otis	U.S.A.	1852
Locomotive	Richard Trevithick	Britain	1804
Machine Gun	James Puckle	Britain	1718
Microphone	Alexander Graham Bell	U.S.A.	1876
Microscope	Z. Janssen	Netherlands	1590
Motor Cycle	G. Daimler	Germany	1885
Photography (on film)	John Carbutt	U.S.A.	1888
Printing Press	Johann Gutenberg	Germany	c.1455
Razor (safety)	King C. Gillette	U.S.A.	1895
Refrigerator	James Harrison & Alexander Catlin	U.S.A.	1850
Safety Pin	Walter Hunt	U.S.A.	1849
Sewing machine	Barthelemy Thimmonnier	France	1829
Ship (steam)	J.C. Perier	France	1775
Ship (turbine)	Hon. Sir C. Parsons	Britain	1894
Skyscraper	W. Le Baron Jenny	U.S.A.	1882
Slide Rule	William Oughtred	Britain	1621
Steam Engine (condenser)	James Watt	Britain	1765
Steel Production	Henry Bessemer	Britain	1855
Steel (stainless)	Harry Brearley	Britain	1913
Submarine	David Bushnell	U.S.A.	1776
Tank	Sir Ernest Swinton	Britain	1914
Telegraph	M. Lammond	France	1787
Telegraph Code	Samuel F.B. Morse	U.S.A.	1837
Telephone (perfected)	Alexander Graham Bell	U.S.A.	1876
Television (mechanical)	John Logie Baird	Britain	1926
Television (electronic)	P.T. Farnsworth	U.S.A.	1927
Thermometer	Galileo Galilei	Italy	1593
Transformer	Michael Faraday	Britain	1831
Transistor	Bardeen, Shockley & Brattain	U.S.A.	1948
Washing Machine (elec.)	Hurley Machine Co.	U.S.A.	1907
Zip-Fastener	W.L. Judson	U.S.A.	1891

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Important Discoveries

Discovery	*Discoverer*	*Nationality*	*Year*
Aluminium	Hans Christian Oerstedt	Denmark	1827
Atomic number	Henry Moseley	England	1913
Atomic structure of matter	John Dalton	England	1803
Chlorine	C.W. Scheele	Sweden	1774
Electromagnetic induction	Michael Faraday	England	1831
Electromagnetic waves	Heinrich Hertz	Germany	1886
Electromagnetism	Hans Christian Oersted	Denmark	1920
Electron	Sir Joseph Thomson	England	1897
General theory of relativity	Albert Einstein	Switzerland	1915
Hydrogen	Henry Cavendish	England	1766
Law of electric conduction	Georg Ohm	Germany	1827
Law of electromagnetism	Andre Ampere	France	1826
Law of falling bodies	Galileo	Italy	1590
Laws of gravitation & motion	Isaac Newton	England	1687
Laws of planetary motion	Johannes Kepler	Germany	1609-10
Magnesium	Sir Humphry Davy	England	1808
Neptune (Planet)	Johann Galle	Germany	1846
Neutron	James Chadwick	England	1932
Nickel	Axel Cronstedt	Sweden	1751
Nitrogen	Daniel Rutherford	England	1772
Oxygen	Joseph Priestly, C.W. Scheele	England, Sweden	1772
Ozone	Christian Schonbein	Germany	1839
Pluto	Clyde Tombaugh	U.S.A	1930
Plutonium	G.T. Seaborg	U.S.A	1940
Proton	Ernest Rutherford	England	1919
Quantum Theory	Max Planck	Germany	1900
Radioactivity	Antoine Bacquerel	France	1896
Radium	Pierre & Marie Curie	France	1898
Silicon	Jons Berzelius	Sweden	1824
Special theory of relativity	Albert Einstein	Switzerland	1905
Sun as centre of solar system	Copernicus	Poland	1543
Uranium	Martin Klaproth	Germany	1789
Uranus (Planet)	William Herschel	England	1781
X-rays	Wilhelm Roentgen	Germany	1895

Scientific Instruments

Name of Instrument	*Used for*
Altimeter	measuring altitude
Ammeter	measuring strength of an electric current
Anemometer	measuring the velocity of wind
Audiometer	measuring level of hearing
Barometer	measuring atmospheric pressure

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Name of Instrument	Used for
Callipers	measuring the internal and external diameters of tubes
Calorimeter	measuring quantity of heat
Compass	finding out direction
Dynamo	converting mechanical energy into electrical energy
Galvanometer	detecting and determining the strength of small electric currents
Hydrometer	measuring specific gravity of a liquid
Hygrometer	measuring the humidity in the atmosphere
Lactometer	measuring the purity of milk
Manometer	measuring the gaseous pressure
Micrometer	measuring minute distances, angles, etc.
Microscope	seeing magnified view of very small objects
Photometer	measuring intensity of light from distant stars
Pyrometer	measuring high temperatures
Radar	detecting and finding the presence and location of moving objects like aircraft, missile, etc.
Radiometer	measuring the emission of radiant energy
Rain Gauge	measuring the amount of rainfall
Seismograph	measuring and recording the intensity and origin of earthquake shocks
Sextant	measuring altitude and angular distances between two objects or heavenly bodies
Spectrometer	measuring the refractive indices
Spherometer	measuring the curvature of spherical objects/surface
Sphygmomanometer	measuring blood pressure
Stethoscope	ascertaining the condition of heart and lungs by listening to their function
Stroboscope	viewing objects that are moving rapidly with a periodic motion as if they were at rest
Tachometer	measuring the rate of revolution or angular speed of a revolving shaft
Telescope	viewing magnified images of distant objects
Thermocouple	measuring the temperature inside furnaces and jet engines
Thermometer	measuring human body temperature
Thermostat	regulating constant temperature
Ultrasonoscope	measuring utrasonic sounds
Viscometer	measuring the viscosity of a fluid
Voltmeter	measuring potential difference between two points.

CHEMISTRY

ELEMENTS

- An element may be defined as a substance which is made by same type of atoms and it can neither be broken into, nor built from two or more simpler substances by any known physical or chemical methods, e.g., copper, silver, hydrogen, carbon, oxygen, nitrogen, gold, iron etc.

COMPOUNDS

- A compound may be defined as a substance which contains two or more elements combined in some fixed proportion by weight and which can be decomposed into two or more elements by any suitable method.
- The properties of a compound are entirely different from those of the elements from which it is made.
- Some common examples of compounds are water, sugar, salt, aspirin, chloroform, alcohol and ether.

MIXTURES

- A material containing two or more elements or compounds in any proportion is a mixture.
- The components of a mixture can be separated by physical means like filtration, sublimation and distillation.

ATOMIC STRUCTURE

ATOM

- Atom is the smallest part of the element that takes part in a chemical reaction. Atom of an element can not be changed into that of another element by a chemical or physical means. It does not exist in free state.

MOLECULE

- A molecule is the smallest part of an element or compound that is capable of existing independently.

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ATOMIC WEIGHT (OR ATOMIC MASS)

- The atomic mass of an element is the number of times its atom is heavier than 1/12th of the mass of carbon (C^{12}) atom.
- The unit used to measure atomic mass is called atomic mass unit, *i.e.,* amu.

ELECTRON

- The electron is a fundamental particle of an atom which carries a unit negative charge. It was discovered by J.J. Thomson in 1897.

PROTON

- It is a fundamental particle of an atom carrying a unit positive charge. It was discovered by Rutherford and Goldstein in 1886.

NEUTRON

- It is a fundamental particle of an atom carrying no charge. It was discovered by Chadwick in 1932.

ISOTOPES

- The atoms of the same element having different mass numbers are called isotopes.

ISOBARS

- Elements having the same atomic mass but differ in atomic number are called isobars.

ISOTONES

- Elements having the same number of neutrons are called isotones.

OXIDATION AND REDUCTION

- Oxidation is a process in which a substance adds on oxygen or loses hydrogen. In modern terms, oxidation is the process in which a substance loses electrons.
- Reduction is a process in which a substance adds on hydrogen or loses oxygen. In modern terms, reduction is the process in which a substance gains electrons.
- Oxidation and reduction always occur simultaneously. If one substance is oxidised, another is reduced. The reaction in which this oxidation-reduction process occurs is called a redox reaction.
- Oxidising agents are substances which bring about the oxidation of other substances, e.g., Potassium Permanganate, Potassium Dichromate, Nitric Acid, Hydrogen Peroxide, etc.
- Reducing agents are substances which bring about the reduction of other substances, e.g., hydrogen sulphide, hydrogen, carbon, sulphur dioxide, etc.

ACIDS, BASES AND SALTS

ACID

- An acid is any compound that can react with a base to form a salt, the hydrogen of the acid being replaced by positive metallic ion. According to modern theory, an acid is a compound which yields hydrogen ions (protons) to a base in a chemical reaction. In a water solution, an acid tastes sour, turns blue litmus red and produces free hydrogen ions.

Acid	Sources
Citric Acid	Lemons or Oranges (Citrus Fruits)
Lactic acid	Sour milk
Tartaric acid	Grapes
Acetic acid	Vinegar
Maleic acid	Apples
Oxalic acid	Tomato
Formic acid	Red ants

BASES

- Such compounds which gives salt and water with acid known as bases. Bitter in taste, turns red litmus paper into blue, contains replaceable hydroxyl group.
- Some important bases are sodium hydroxide, potassium hydroxide, sodium carbonate and ammonium hydroxide.
- All alkalies are bases but all bases are not alkalies because all bases are not soluble in water.

SALTS

- Salts are ionic compounds containing a positive ion (cation) and a negative ion (anion).
- When an acid reacts with a base, a salt and water are formed. This reaction is called neutralization since the acid and base neutralize each other's effect.

ELECTROLYSIS

- The process of decomposition of an electrolyte by the passage of an electric current through its molten state or its aqueous solution is called electrolysis.
- Device through which electric current is passed known as electrodes.

METALLURGY

- Metals occur in nature, in the native (in free state) as well as in the combined state.
- Naturally occurring materials containing metals are called minerals.
- A mineral from which a given metal is obtained economically is called an ore.
- The process of extraction of a metal in a pure state on a large scale from its ore by Physical and Chemical means is called metallurgy.
- The rocky and siliceous matter that associated with the ore is known as gangue.
- Substance that is added to ore to remove the gangue is known as flux.

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- The process of removal of gangue from the ore is known as concentration.
- Calcination is the heating of the ore in the absence of air. This method is employed for obtaining the metal oxides from carbonates and hydroxides.
- Roasting is the heating of the ore in the presence of air. On roasting, part of the ore is oxidised to form an oxide. This oxide is then reduced to the metal.
- The industrial reduction process for obtaining metal from the treated ore is called smelting.

AMALGUM

- An alloy in which one of the component metals is mercury is known as amalgum.

IRON AND STEEL

- Iron is extracted from its ores by the blast furnace process.
- Iron obtained from blast furnace is called pig iron or cast iron containing about 5% carbon.
- Pure iron is called wrought iron which does not contain carbon more than 0.2%, or any other impurities or constituents.
- Steel contains 0.25% – 2% carbon and varying amounts of other elements.

CARBON AND ITS COMPOUNDS

ALLOTROPY

- Such substances which having the same chemical properties, but differ in physical properties, known as allotropes and this property is called allotropy.

DIAMOND

- Diamond is the purest form of carbon.
- It is non-conductor of heat and electricity.
- It is the hardest natural substance.
- It burns in air at 900°C and gives out CO_2.

GRAPHITE (BLACK LEAD)

- It is good conductor of heat and electricity.
- Graphite is used in making lead pencils.
- Graphite is also used as electrodes, lubricant, moderators, electrotyping and carbon arc.

AMORPHOUS FORMS OF CARBON

1. Wood Charcoal – Obtained from wood
2. Sugar Charcoal – Obtained from cane sugar
3. Bone or Animal Charcoal – Obtained from animal bones
4. Coke Charcoal – Obtained from coal

CARBON MONOXIDE (CO)

- Carbon monoxide is an active poison and is very dangerous as it is a colourless and odourless gas and can not, therefore, be easily detected.
- The extremely poisonous nature of carbon monoxide is a result of its combining with the haemoglobin of the blood to form carbo-xyhaemoglobin, which is not decompassed by any of the processes in the body.

HYDROCARBONS

- Compounds of carbon and hydrogen are called hydrocarbon.
- A natural source of hydrocarbon is petroleum obtained from sedimentary rocks.
- Compounds having the same molecular formula but differ in properties due to different structural formula known as isomers and this property is called isomerism.

SATURATED HYDROCARBONS (ALKANES)

- Containing single covalent bonds only.
- Such compounds are, in general, called alkanes for instance, Methane, Ethane, Propane, Butane.

UNSATURATED HYDROCARBONS

- Containing multiple bonds.
- Compounds with double bonds are called alkenes, e.g. ethylene, propyene etc. and triple bond containing compounds are called alkynes, e.g. acetylene, propyne etc.
- Benzene is an unsaturated cyclic hydrocarbon with the structure.
- Compounds derived from benzene are called aromatic compounds.

FUELS

Solid Fuels

- These contain carbon and, during combustion, form mainly carbon dioxide and carbon monoxide with a large amount of heat.
- Examples of solid fuels are wood, coal, coke and paraffin wax.

Liquid Fuels

- These are basically mixtures of several hydrocarbons. During combustion, they form carbon dioxide and water.
- Liquid fuels are obtained as different fractions during the distillation of petroleum.
- Examples of liquid fuels are kerosene oil, petrol, diesel oil and alcohol.

Gaseous Fuels

- Gaseous fuels do not leave ash on burning and have high content of heat.
- The main gaseous fuels are liquefied petroleum gas (LPG, mainly a mixture of propane and butane and used in homes for cooking, water gas ($CO + H_2$), producer gas ($CO + N_2$), coal gas (mixture of hydrogen, methane, ethylene, carbon monoxide, nitrogen, oxygen and carbon dioxide) and natural gas (mixture of methane, ethane, propane and butane with traces of higher hydrocarbons obtained from oil well, above petroleum).

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PETROLEUM AND NATURAL GAS

- Natural gas contains about 80% methane and 10% ethane, the remaining 10% being a mixture of higher gaseous hydrocarbons.
- Compressed Natural Gas (CNG) is natural gas filled in cylinders under high pressure.
- The quality of petrol for use in car engines is denoted by their anti-knock properties.
- To increase octane number, tetra ethyl lead (TEL) is added to petrol.

HEAVY WATER

- Chemically heavy water is deuterium oxide.
- Heavy water is used in nuclear reactors as a moderator because it slows the fast moving neutrons.

Hard and Soft Water

- Water which produces lather with soap solution readily is called soft water.
- Water which does not produce lather with soap solution readily is called hard water.
- The hardness of water is due to presence of the bicarbonates, chlorides and sulphates of calcium and magnesium.
- Temporary hardness of water is due to the presence of bicarbonates of calcium and magnesium.
- Permanent hardness of water is due to presence of sulphates, chlorides, nitrates of calcium and magnesium.

GLASS

- Ordinary glass is solid mixture of silica, sodium silicate and calcium silicate.
- Soft glass is a soda-lime silicate glass. It melts at low temperature. It is used in manufacturing of bottles, test tubes etc.
- Hard glass is potash lime silicate and melts at high temperature in comparison to soft glass and is used in manufacturing of flask etc.
- Flint glass is a lead potash silicate and is used in manufacturing of prism, lens and optical instruments.
- Pyrex glass is a mixture of sodium aluminium borosilicates. It is used in manufacturing of high quality equipments in laboratory because it does not melt at very high temperature.
- Safety glass is prepared by placing a layer of transparent plastic glass between two layers of glass by means of a suitable adhesive. It is used in making wind screen of automobiles, aeroplanes, trains etc.

CEMENT

- The approximate composition of Portland cement is:
  1. Calcium Oxide → 62%
  2. Silica → 22%
  3. Alumina → 7.5%
  4. Magnesia → 2.5%
  5. Ferric Oxide → 2.5%
- A small amount of gypsum is added to slow down the setting of cement.
- Cement containing excess amount of lime cracks during setting while cement containing less amount of lime is weak in strength.
- Cement containing no iron is white but hard to burn.

POLYMERS AND PLASTICS

- A polymer is a large molecule, built up from many hundreds of thousands of small unit called monomeric units or monomers.
- The process of formation of polymers from monomers is called polymerization.
- Plastics are cross-linked polymers and very tough.
- Some examples of plastics are — Celluloid, Bakelite and Vinyl Plastics.

RUBBER

- Natural and Synthetic rubbers are examples of polymers.
- Natural rubber is isomer of isoprene.
- When the natural rubber is heated along with sulphur called vulcanisation. The resulting rubber is elastic, hard and strong.
- Synthetic rubbers are made by polymerisation of chloroprene, styrene and butadiene mixtures and isobutylene.

SOAPS

- The soaps are sodium salts of higher fatty acids. They are useful only in soft water as they form an insoluble precipitate in hard water. This precipitate consists of salts of calcium and magnesium of higher fatty acids. No lather or emulsion is formed and washing is not possible.

Some Importants Alloys

Alloys	*Composition*
Brass	Cu, Zn
Bronze	Cu, Sn
Gun metal	Cu, Sn, Zn
Bel metal	Cu, Sn
German silver	Cu, Zn, Ni
Dutch metal	Cu, Zn
Aluminium	Al, Cu
Nichrome	Ni, Fe, Cr, Mn
Chromium steel	Cr, C, Fe

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Chemical Formulae, Commercial Name of Chemical Compounds

Commercial Name	Chemical Compounds	Chemical formulae
Common salt	Sodium chloride	NaCl
Baking soda	Sodium bicarbonate	$NaHCO_3$
Washing soda	Sodium carbonate	$Na_2CO_3 . 10H_2O$
Caustic soda	Sodium hydroxide	NaOH
Chilli salt peter	Sodium nitrate	$NaNO_3$
Soda ash	Sodium carbonate	Na_2CO_3
Hypo	Sodium thiosulphate	$Na_2S_2O_3 . 5H_2O$

BIOLOGY

BRANCHES OF BIOLOGY

(*a*) **Anthropology:** Deals with the scientific study of man and the mankind.

(*b*) **Agronomy:** Deals with the management of farms and science of crop production.

(*c*) **Apiculture:** Deals with the process of bee keeping for commercial purposes.

(*d*) **Entomology:** Deals with the structure, habits and classification of insects.

(*e*) **Eugenics:** Deals with improving the human race.

(*f*) **Pathology:** Deals with the nature of disease, their causes, symptoms, effects, their cure and control.

(*g*) **Physiotherapy:** Deals with the treatment of diseases, body weakness or defects with the help of massage and exercise etc.

(*h*) **Sericulture:** Deals with the production of raw silk from silkworm.

(*i*) **Pharmacology:** Deals with the knowledge and manufacture of drugs.

(*j*) **Occupational therapy:** Deals with treating the physically handicapped or injured persons through exercise etc.

(*k*) **Psychology:** Deals with the study of human mind, its behaviour and mental qualities.

(*l*) **DNA finger printing:** Technique to help identify a person on the basis of genes.

ANIMALS/PLANTS

- The organisms that closely resemble one another are placed in one group, the groups which have similarities are combined together into larger groups, and these into still larger ones. The most inclusive category is kingdom. Other major categories, in descending order are: phylum, class, order, family, genus, and species. Man belongs to Animal kingdom, chordata division or phylum, Mammalia class, Primates order, Hominidae family, Homo genus and Sapiens species.

CELL THEORY

- Cell is the basic unit of structure of all living organisms. According to the cell theory, all organism are composed of cells and cell products and growth and development results from the division and differentiation of cells.
- Cells membrane surrounds all living cells.
- Nucleus is the most important cell organelle which controls and coordinates all cell activities and also concerned with the transmission of heredity characters.
- Mitochondria, ribosomes, lysosomes and dictyosomes are present in plant and animal cells.
- Only plant cells have cell wall, chloroplast and vacuole.
- Viruses constitute a difficulty since in many ways they are intermediate between living and dead matter.
- The cell is said to be made up of a substance called Protoplasm which has two main constituents cytoplasm and nucleus, and is bounded by a cell membrane on outside.
- Cells take up the raw materials for metabolism through the cell membrane from extracellular fluid surrounding them.
- Cytoplasm inside is responsible for maintaining the internal distribution of organelles and also for free cell movements.
- Mitochondria inside provides energy for reactions inside the cell. Ribosomes are responsible for the synthesis of proteins.
- The Endoplasmic Reticulum helps in addition of other sugar units to proteins and their transportation to other parts of the cell.

FOOD

- It is a nutritive substance taken by an organism for growth, work, repair and maintaining life processes. It provides energy to do work and maintain body heat, provides materials for the growth of the body, makes necessary materials for reproduction and provides materials for the repair of damaged cells and tissues of our body.

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- **Carbohydrates:** For a normal person, 400 to 500 gms of carbohydrates are required daily but for sportspersons, growing children and nursing mothers, it is on higher side.
- **Proteins:** They are complex organic compounds made up of carbon, hydrogen, oxygen and nitrogen. The building blocks of Protein are Amino acids and there are large number of amino acids.
- Proteins are essential for the growth of children and teenagers, and for maintenance and making good the wear and tear of the body tissues in adults.
- An adult needs about 1 gm of protein per kg of body weight.
- **Fats:** They are esters of long chain fatty acids and an alcohol called glycerol. Fats also contain atoms of carbon, hydrogen and oxygen.
- The main function of fats in the body is to provide a steady source of energy and for this purpose, they are deposited within the body.
- One gm of fat gives 37 kilojoules of energy which is more than double of that given by carbohydrates.
- Fats, the richest source of energy to our body, can be stored in the body for subsequent use. Fats, soluble in organic solvents and insoluble in water, also supply fat-soluble vitamins to our body.
- **Minerals:** Some of the important minerals needed by our body are — iron, iodine, calcium, phosphorus, sodium, potassium, zinc, copper, magnesium, chloride, fluoride and sulphur.
- We get most of the minerals in combined form from plant sources. Deficiency of these minerals causes many diseases.
- **Energy Requirements:** The energy requirement of a body varies according to age, sex, lifestyle, occupation, climate and special situations like pregnancy and lactation.

Age	*Energy requirements*
5 years	6000 kJ per day
11 years	9000 kJ per day
18 years	11000 kJ per day
Adult (normal work)	9600 kJ per day
Adult (heavy work)	12000 kJ per day
Adult (very heavy work)	16000 kJ per day

- **Vitamins:** They act as catalysts in certain chemical reactions of metabolism in our body.
- They don't provide energy to our body nor form body tissues.
- More than 15 types of vitamins are known and only 2 vitamins — D and K can be formed in our body.

Vitamin	*Necessity*	*Source*
Vitamin A	For maintaining healthy eyesight, normal skin and hair	Cod liver oil, fish, eggs, milk, carrot, leafy vegetables.
Vitamin B_1	For growth, carbohydrate metabolism, functioning of heart, nerves and muscles.	Milk, soya-food, meat, whole cereals, green vegetables.
Vitamin C	For keeping teeth, gums and joints healthy, for increasing resistance of body to infection	Citrus fruits, guava, tomatoes.
Vitamin D	For normal growth of bones and teeth	Milk, eggs, butter, cod liver oil, sun light.
Vitamin E	For normal reproduction, functioning of muscles and protection of liver	Green leafy vegetables, milk, butter, tomato.
Vitamin K	For normal clotting of blood and normal functioning of liver	Green leafy vegetables, soyabean, tomato.

- **Roughage:** Though it does not provide any energy to the body, yet keeps the digestive system in order, by helping in retaining water in the body and preserving constitution.
- The main source of roughage are salads, cabbage, corn cob, porridge, vegetables and fruits with stems.

DISEASES

COMMUNICABLE DISEASES

- They are the diseases which can be transmitted from reservoirs of infection or infected person to the healthy but susceptible persons.
- The disease causing agent or the pathogen can be transmitted directly or indirectly.

DEFICIENCY DISEASES

- These occur due to deficiency of some nutrients in the diet or some hormone due to hypo activity or damage to endocrine glands.

Diet Deficiency	*Disease*
Protein	Kwashiorkor
Protein-energy malnutrition	Marasmus
Vitamin A	Night-blindness, Xerophthalmia
Vitamin B_1	Beri-Beri
Vitamin B_2	Cheilosis
Vitamin B_5	Pellagra
Vitamin C	Scurvy

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Vitamin D	Rickets (in children), (in adult) Osteomalacia
Vitamin K	Hypothrombinemia
Iron	Anaemia
Iodine	Goitre
Fluoride	Dental caries
Calcium and phosphorus	Affects formation of bones and teeth

Hormone Deficiency	*Disease*
Insulin	Diabetes
Thyroxine	Cretinism (child), Goitre
STH	Dwarfism, Gigantism

ALLERGIC DISEASE

- In these diseases, body becomes hypersensitive to some foreign agents, allergens, which cause inflammation when come in contact with the body or enter inside the body.
- Foreign agents can be dust, pollens, certain-foods, serum, certain drugs or fabrics.
- The unfavourable response of the body to allergens is called allergic reaction. Asthma and hay fever are allergic diseases.

BACTERIAL DISEASES

- Bacteria are minute organisms which are known to cause a number of diseases:

Disease	Incubation period	Spread through
Tuberculosis	2-10 weeks	Air-borne,droplet infection
Diptheria	2-6 days	Air-borne droplet infection
Cholera	6 hours to 2-3 days	Contaminated food and water. House flies are the vectors
Leprosy	Upto 5 years	Prolonged and intimate contact
Whopping cough	7-14 days	Droplet infection
Tetanus	3-21 days	Entry of cysts through any wound made by sharp object, dog bite or fall on the road
Typhoid	1-3 weeks	Directed and Contact
Plague	2-6 days	Rats and bed-bugs transmit the germs
Pneumonia	1-3 days	Air-borne

VIRAL DISEASES

Disease	Incubation period	Spread through
Chicken-pox	12-20 days	Direct contact with infected persons or infected objects
Smallpox	12 days	Droplet infection
Poliomyalitis	7-14 days	Direct and oral
Measles	10 days	Droplet infection
Mumps	12-26 days	Droplet infection
Rabies	1-3 months	Bite of rabied animal like dogs, monkeys, cats
Influenza	24-28 hours	Air-borne

DISEASES CAUSED BY PROTOZOA

- Amoebiasis (Amoebic dysentery), Malaria, Kala-azar, Trypanosomiasis and Giardiasis are main diseases caused by Protozoans.
- Malaria is a parasitic infection.

SYSTEM OF HUMAN BODY

DIGESTIVE SYSTEM

- The digestive system consists of alimentary canal and digestive glands. Alimentary canal is about 8-10 meters long tube of varying diameter. Food is taken in through mouth.
- The tongue helps in ingestion, chewing, tasting and swallowing of food and mixing of food and saliva.
- Salivary glands secret saliva which helps in digestion of starch. Gastric glands present in the mucosa of the stomach, provide acidic medium for the food digestion.
- Liver, the largest sized, reddish brown gland of body, secrets bile. Liver is present in the right upper part of the abdomen. The bile secreted by the liver is stored in gall bladder. It helps in the emulsification and digestion of fats.
- Pancreas is the second largest gland in human body and secretes pancreatic juices. Intestine also secret juices.

RESPIRATORY SYSTEM

- Oxygen is needed for the oxidation and expelling of carbon dioxide is necessary to avoid its-accumulation. This process of exchange of gases between the environment and the body, is called respiration.
- In some unicellular organisms like aerobic bacteria, amoeba, hydra, etc. there is direct exchange of gases between the carbon dioxide of the body and oxygen of water.
- There is no blood for transport of gases. However, in larger and complex form of animals, specialised respiratory organs are developed.
- Amphibians respire through skin, fishes through gills and mammals, birds and reptiles through lungs.
- A normal adult inspires or expires about 500 ml of gas with each breath and about 72 breathes per minutes.

CIRCULATORY SYSTEM

- Main components of the circulatory system are heart, blood vessels and blood.
- Heart is a thick, muscular, contractile and automatic pumping organ. In birds and mammals, heart is divided into four chambers.

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- Arteries are thick walled blood vessels which always carry the blood away from the heart to various body parts.
- Veins are thin walled blood vessels which always carry the blood from various parts generally to the heart.
- In an adult healthy person, the normal rate of heart beat at rest is about 70-72 times per minute.

BLOOD

- It is red, opaque, somewhat sticky and viscous fluid in the body of animals.
- It is slightly alkaline (pH = 7.4), heavier than water (sp gr = 1.05) and five times more viscous than distilled water.
- Blood forms 6 to 10% of the body weight.
- An adult, on average, has about 6.8 litres of blood.
- Blood contains plasma and blood corpuscles with the former occupying 55-60% of the volume.
- Plasma transports food components, metabolic wastes and hormones; keeps constant level of pH of blood, maintains body temperature and helps in blood clotting.
- Erythrocytes or red blood corpuscles (RBCs), leukocytes or white blood corpuscles (WBCs) and blood platelets are other parts of the blood.
- Due to the presence of iron containing pigment haemoglobin, RBCs are red in colour. The RBCs are crucial for ex-change of oxygen and carbon dioxide. WBCs are nucleated and non-pigmented cells. They are larger in size than RBCs but far less in number (1 : 600).
- WBCs play an important role in immune system of the body. Blood platelets cause the coagulation of blood and clot formation to prevent excessive bleeding.
- Human blood is divided into four main Groups—A, B, AB and O.
- The plasma of Group A blood contains an anti-B factor and vice-versa, so that people of Groups A and B cannot accept each other's blood.
- Group AB contains neither anti-A nor anti-B factor and people with this group can receive transfusions from both but can give to neither.
- Group O contains both anti-A and anti-B and can receive blood only from Group O but can donate blood to all Groups. Group O is called universal donor because they can donate to all the Groups.
- Group AB is called universal acceptor because they can accept blood from all Groups.

SKELETON SYSTEM

- The frame or the hard structure of the human body is composed from the bones and the organs of making such frame are called skeleton system.

Bones

- Bone is the hardest tissue of the body and form the largest section of the body weight.
- Bones contain organic as well as inorganic matters. With advancing age, the inorganic matter's share increases, causing the bones to become more brittle.
- Long bones such as humerus and femur are hollow while small bones are solid.

EXCRETORY SYSTEM

- In men, excretory system is formed of one pair of kidneys, one pair of ureters, a urinary bladder and a urethra. Kidney is about 10 cm long, bean shaped, dark-red and slightly flattened structure.
- Sweet glands, oil glands, lungs and liver also act as additional excretory organ.
- In case of kidney failure, a man can treated by hemodialysis or transplantation of a kidney from a donor's body.

NERVOUS SYSTEM

- The system which controls and coordinates the body functions, retains memory and receives and sends signals, is called the nervous system.
- The nervous system comprises brain, spinal cord, nerves and nerve fibres.
- Human brain weighs about 1200 to 1400 gm. Main parts of the brain are cerebrum, cerebellum and medulla oblongata.
- Cerebrum controls voluntary function and is site of intelligence, will power, emotions, etc.
- Cerebellum controls involuntary functions like heart beat, respiration, etc.
- Spinal cord is about 45 cm long and about 35 gm in weight. It conducts impulses to and from the brain and controls reflex actions of the body.
- Various cranial (arising from ending into brain) and spinal nerves (arising from spinal cord) control smell, vision, movements of body parts, taste and hearing.

REPRODUCTION SYSTEM

- In this type of reproduction, there is formation and fusion of sex cells, called gametes.
- Organism develops from the zygote through embryo formation.
- It generally involves two parents — male and female.
- The offsprings are different from the parent as variations appear due to new combinations of genes. So, it plays an important role in evolution.
- All higher plants and animals reproduce sexually.

CHROMOSOMES

- Plants and animals have fixed number of chromosomes per cell.
- Genes are located on chromosomes and are responsible for transfer of characteristics from one cell to the next either in the same organism or from parents to offspring.

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- Man has 23 pairs of chromosomes, of which one pair is sex chromosomes.
- Males child inherits X chromosomes from the female parent and Y from the male parent.
- Female child receives a X chromosome each from either of its parents.
- Mendel was the first scientist to explain transmission of units from reproductive cells of the parents to the off-springs.

CLONING

- It is the process of producing genetically identical copies of a biological material, starting from a single cell. The original genes are transplanted and thus one can produce organisms of known and desirable characteristics.

GENETIC ENGINEERING

- It is the method of artificial synthesis of new genes and their subsequent transplantation or methods of correcting the defective genes.
- It has helped in producing plants and animals with specific characters.
- So, crippling hereditary diseases can also be cured like hemophilia etc.

DNA FINGERPRINTING

- It consists of examining repetitive DNA in the genome for variations in the length of restriction fragments.
- Every individual has his own pattern, so that fingerprinting can match blood to a particular person, and patterns are inherited from parent to child, allowing the method to identify relationships between individuals.

IN-VITRO FERTILIZATION

- When a sperm and an egg are made to fertilize outside a living body (usually a test tube), it is called in-vitro fertilization.
- This process has been used to impregnate several females who could not do so through natural means.

Diseases and the Parts of Body they Affect

AIDS—Immune system of body	*Gout*—Joints of bone
Arthritis—Inflammation of joints	*Jaundice*—Liver
Asthma—Lungs	*Meningitis*—Brain or spinal cord
Cataract—Eyes	*Pleurisy*—Pleura (inflammation of)
Conjunctivitis—Eyes	*Polio*—motor neurons
Diabetes—Pancreas	*Pneumonia*—Lungs
Diphtheria—Throat	*Pyorrhoea*—Sockets of teeth
Glaucoma—Eyes	*Tuberculosis*—Lungs
Eczema—Skin	*Typhoid*—Intestine
Goitre—Front of the neck (due to enlargement of thyroid gland)	*Malaria*—Spleen
	Leukaemia—Blood
	Rickets—Bones

SPACE RESEARCH

First in Space

✶ First creator of rules regarding space research	Isaac Newton
✶ First artificial satellite launched in space	Sputnik-1 (1957)
✶ First living being sent in space	Louika (a dog)
✶ Firstever manned spacecraft	Vostok-I
✶ First man in space	Yuri Gagarin U.S.S.R. (1961)
✶ First woman in space	Valentina Tereshkova U.S.S.R. (June 1963)
✶ First man who moved in space out of the spacecraft	Alexi Livonov U.S.S.R. (June 1965)
✶ First person to land on moon	Neil Armstrong, America (21st July, 1969)
✶ First fourwheeled carriage without human being on moon	Leunokhev-I U.S.S.R. (1970)
✶ First space lab in orbit	Skylab (America, 1973)
✶ First space shuttle	Columbia (America, 1981)
✶ First Indian (man) in space	Squadron leader—Rakesh Sharma (13th April, 1984)
✶ First Indian (Woman) in space	Kalpana Chawla (19th Nov., 1997)
✶ First American woman in space	Sailyride (1983)
✶ First spacecraft on Mars	Pathfinder (6 July, 1997)
✶ First woman who lead spacecraft	Allin Collis (America)
✶ First spacecraft without man	Shenzoo, China (20th Nov. 1999)

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Indian Space Programme : At a Glance

Satellite	Date	Type	Launch Vehicle	Result
Aryabhatta	19-04-75	Scientific	Cosmos	successful
Bhaskara I	07-06-79	Geosurvey	Cosmos	successful
Rohini	10-08-79	Geosurvey	S.L.V.3	unsuccessful
Rohini D-1	18-07-80	Geosurvey	S.L.V.3	successful
Rohini	31-05-81	Scientific	S.L.V.3	successful
Apple	19-06-81	Communication	Ariane	successful
Bhaskara II	20-11-81	Geosurvey	Cosonos	successful
INSAT-1A	10-04-82	Multipurpose	Delta	unsuccessful
Rohini	17-04-83	Scientific	S.L.V.3	successful
INSAT-1B	30-08-83	Multipurpose	Space Shuttle	successful
SROSS I	24-03-87	Technical	ASLV-D1	unsuccessful
IRS-1A	17-03-88	Remote sensing	Vostok	successful
SROSS II	17-07-88	Technical	ASLV-D2	unsuccessful
INSAT-1C	21-07-88	Multipurpose	Ariane-4	unsuccessful
INSAT-1D	12-06-90	Multipurpose	Delta	successful
IRS-1B	29-08-91	Remote sensing	Vostok	successful
INSAT-2A	10-07-92	Multipurpose	Ariane	successful
IRS-ID	29-09-97	Remote sensing	PSLV	successful
INSAT-3B	22-03-2000	Multipurpose	Ariane	successful
G-SAT-1	18-04-2001	Multipurpose	GSLV-D	successful
MAT SAT	12-09-2002	Meteorology	PSLVC-4	successful
INSAT-3E	28-09-2003	Communication	Ariane-5	successful
Cartosat-1 & hamsat	05-05-2005	Maping and Communication	PSLV-C6	successful
CARTOSAT-2	10-01-2007	Communication	PSLV-C7	successful
Cartosat-2A	28-04-2008	Communication	PSLV-C9	successful
Chandrayaan-I	22-10-2008	Maping and Scientific	PSLV-C11	successful
Oceansat-2	24-09-2009	Remote Sensing	PSLV-C14	successful
CARTOSAT-2B	12-07-2010	Communication	PSLV-C15	successful
RESOURCESAT-2	20-04-2011	Remote Sensing	PSLV-C16	successful
GSAT-12	15-07-2011	Communication	PSLV-C17	successful
Megha-Tropiques	12-10-2011	Maping and Scientific	PSLV-C18	successful
RISAT-1	26-04-2012	Remote Sensing	PSLV-C19	successful
Spot-6	09-09-2012	Remote Sensing	PSLV-C21	successful
Saral	25-02-2013	Scientific	PSLV-C20	successful
GSAT-7	30-08-2013	Defence	Ariane-5	successful
MOM	5-11-2013	Mapping	PSLV-C25	successful
GSAT-14	05-01-2014	Communication	GSLV-D5	successful
IRNSS-1B	04-04-2014	Mapping and Scientific	PSLV-C24	successful
Spot-7	30-06-2014	Remote Sensing	PSLV-C23	successful
GSAT-16	07-12-2014	Communication	Ariane-5	successful
IRNSS-1D	28-03-2015	Mapping and Scientific	PSLV-C27	successful
GSAT-6	27-08-2015	Communication	GSLV-D6	successful
Astrosat	28-09-2015	Mapping and Scientific	PSLV-C30	successful
GSAT-15	11-11-2015	Communication	Ariane-5	successful
TELEOS-1	16-12-2015	Mapping and Scientific	PSLV-C29	successful
IRNSS-1E	20-01-2016	Mapping and Scientific	PSLV-C31	successful
IRNSS-1F	10-03-2016	Mapping and Scientific	PSLV-C32	successful
IRNSS-1G	28-04-2016	Mapping and Scientific	PSLV-C33	successful
Cartosat-2 & others	22-06-2016	Mapping and Scientific	PSLV-C34	successful

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Satellite	Date	Type	Launch Vehicle	Result
insat-3DR	08-09-2016	Meteorology	GSLV-F05	successful
Scatsat-1 & others	26-09-2016	Multipurpose	PSLV-C35	successful
RESOURCESAT-2A	07-12-2016	Remote Sensing	PSLV-C36	successful
CARTOSAT-2 & 103 others	15-02-2017	Multipurpose	PSLV-C37	successful
GSAT-9	06-05-2017	Communication	GSLV MK-II	successful
GSAT-19	05-06-2017	Communication	GSLV MK-III-D1	successful
CARTOSAT-2E	23-06-2017	Earth observation Satellite	PSLV-C38	successful
GSAT-17	29-06-2017	Earth observation Satellite	Ariane-5 ECA	successful
Cartosat-2F & others	12-01-2018	Multipurpose	PSLV-C40	successful
GSAT-6A	29-03-2018	Communication	GSLV-F08	successful
GSAT-7A	19-12-2018	Military Satellite	GSLV-MK-II-F11	successful
Chandrayaan-2	22-07-2019	Lunar Exploration	GSLV MK-III M01	—
Cartosat-3	27-11-2019	Earth Imagine Satellite	PSLV-C47	successful
GSAT-30	17-01-2020	Communication	Ariane-5	successful
EOS-01	07-11-2020	Earth Observation	PSLV-C49	successful
Amezonia & 19 others	28-02-2021	Communication	PSLV-C51	successful
EOS-04	14-02-2022	Earth Observation	PSLV-C52	successful

COMPUTER

- The computer is the system of that electronic device through which various informations are processed on the basis of a definite set of instructions called program and mathematical (numerical) and non-mathematical both types of informations are processed.
- The first mechanical computer was composed or fabricated by Blaise Pascal in 1642 and it is called Pascalene.
- But in 1833, Charles Babbage first time conceived an automatic calculator or computer.
- Charles Babbage is called the father of modern computer.
- Herman made an electronic tabulating machine based on punch cards which operates automatically.
- In 1937, first mechanical computer Mark-I was fabricated by Howard Akeen.
- The most outstanding contribution in the development of modern computer goes to John Wan Newmaan who brought the 2nd revolution in the area of computer in 1951.
- He discovered EDVAC (Electronic Discrete Variable Automatic Computer) and utilised the stored program and the binary number system in the computer.

FUNCTIONS OF COMPUTER

- 1. Collection and composition (input) of datas;
  2. Storage of datas.
  3. Processing of datas.
  4. Retrieval or output of the proccessed informations and datas.

UNITS OF COMPUTER

1. Input unit.
2. Central processing unit–CPU.
3. External Memory unit.
4. Output unit.

- The CPU of the computer is called brain of the computer and sometimes CPU is also called Micro Processor of the computer.
- The data is entered through the input unit in the computer and through the central processing unit with the help of External Memory Unit datas are arranged and processed.
- Ultimately by the output unit these datas or informations are issued or released.

PARTS OF COMPUTER

- **Monitor :** The monitor of the computer is like a television in which the picture appears in the form of doted points on the screen and these are called pixels.
- **Hard Disc and Floppy Disc :** The Hard Disc is the permanent disc in the computers while the Floppy Disc is the disc utilised when datas or informations are to be transferred from one computer to another.
- **Mouse :** The mouse of the computer is like the remote control of TV through which computer is directly regulated or controlled without utilising the key-board.
- **Printer :** The printer is a device which prints any documents or processed informations of the computer.

SOME HIGH LEVEL LANGUAGES

1. **FORTRAN :** This language was developed for solving the mathematical formulae very quickly and conveniently.
2. **COBOL :** This language was developed for the commerical purposes. For the processing of this

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language a group of sentences is selected called paragraph and all paragraphs composed are called a section, while all sections composed are called a division.

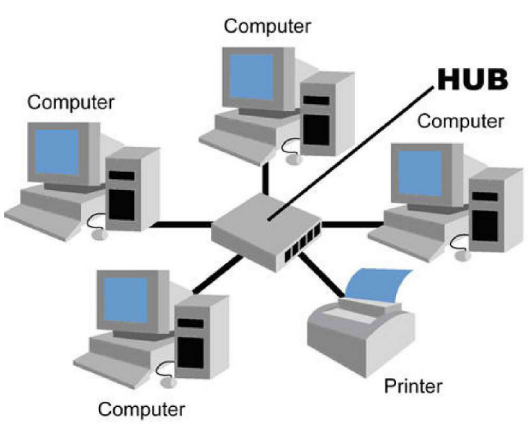
3. **BASIC :** In basic a definite part of the prescribed instruction is only inserted in the computer.
4. **ALGOL :** This was basically fabricated and designed for the complex algebraic calculations.
5. **PASCAL :** It is an amplified and modified form of ALGOL.
6. **COMAL :** This computer language is used for the students of secondary level.
7. **LOGO :** This language is used for children and kids for drawing Graphic line diagrams.
8. **PROLOG :** This language is developed in 1973 in France and is used for Artificial Intelligence which is capable and equivalent to the logical program.
9. **FORTH :** This language was invented by Charles Mure which is frequently used in all types of the works in the computer.

COMPUTER VIRUS

- The computer virus is an electronic code which is used to abolish or erradicate the inclusive informations or programs of the computer.
- Some important computer viruses are Micheleanjalo, Dork Avangor, kilo, filip, Macmug, Scores, Casecade, Jeruslem, Date crime, Coloumbs crime, Internet virus, Pachcom, Pach EXE, COM-EXE, Marizuana, C-brain, bloody, Chenge Mungu and Desi etc.

COMPUTER NETWORKING

- There are two types of networkings which are usually occur—Local Area Networking (LAN) and Wide Area Networking (WAN).



- By LAN all the computers of the same buildings are connected like the computers of university premises, computers of offices etc.
- By WAN all the comptuers of a large area are connected like the computers of all the offices of a city or town etc.
- In India a very large computer network namely INDONET has been installing through which all the main towns and cities has to be interlinked.

COMPUTER TERMINOLOGY

- **Bit :** The bit is a unit of measurement of the electronic data. One bit is either 0 or 1 but not both. On composing 8 bits, 1 byte is formed.
- **Bug :** The Bug is the error in the computer program or system and its eradication is called Debug.
- **Byte :** Total eight bits compose a byte. Thus 8 bits = 1 byte.
- **CD-ROM :** A CD like of music CD in which data can be stored substantially called CD-ROM. In a CD with comparison to floppy extremely more datas can be stored but one problem in it is that one time recorded data can not be deleted or modified.
- **Chip :** It is a thin slice on which by a special mechanism a circuit is designed which is normally made from Silicon.
- **Memory System :** The place where computer data and program are temporarily kept is called Memory system. Usually memory is implied from RAM.
- **Modem :** The device which converts digital signals into analogue signals and vice-versa is called Modem.
- **RAM :** It is Random Access Memory (a place) where datas to be processed are kept temporarily and it is unstable memory.
- **ROM :** It is Read Only Memory and it is stable or Non-valatile memory which doesn't ended after power off.
- **Scanner :** It is a device through which graphic image is transformed to digital image and the scanners are of usually two types one desktop and another hand operating.

PROGRAMING

- Computers perform phenomenal feats of calculation, but they do not do so in a complicated way.
- They actually carry out very simple operations, such as addition and subtraction.
- They achieve their fantastic computing power by carrying out these operations at incredible speed.
- The programme, or set of instructions for operating the computer, is therefore written as a sequence of very simple steps.

  Several computer languages have been developed for different applications, including BASIC, COBOL, FORTRAN and PASCAL. Writing programmes is very skilled and time-consuming work.
- But for most typical computer applications ready-written programmes are available, called “packages”.

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GENERAL KNOWLEDGE

FIRST IN THE WORLD

✶ First Chinese visitor to India	*Fahien*
✶ First foreign invader of India	*Alexander, the Great (Greek)*
✶ First person to climb Mt. Everest	*Tenzing Norgay (India) and Edmund Hillary (New Zealand) (1953)*
✶ First atom bomb dropped at	*Hiroshima (Japan)*
✶ First man in the space	*Yuri Gagarin (former USSR)*
✶ First woman in the space	*Valentina Tereshkova (former USSR)*
✶ First person to walk in the space	*Alexei Leonov (former USSR)*
✶ First person to land on the moon	*Neil Armstrong (USA)*
✶ First and the only woman to have climbed Mt. Everest twice	*Santosh Yadav (Indian; May 12, 1992; May 10, 1993)*
✶ First person on Mt. Everest without oxygen	*Phu Dorjee (Indian; May 9, 1984)*
✶ First person to climb Mt. Everest twice	*Nawang Gombu*
✶ First person to climb Mt. Everest maximum times	*Chhewang Nima Sherpa (19 times)*
✶ First President of the USA	*George Washington*
✶ First woman Prime Minister	*Sirimavo Bandaranaike (Sri Lanka)*
✶ First person to swim across English Channel	*Mathew Webb*
✶ First woman to swim across English Channel	*Gertrude Caroline Ederle*
✶ First woman to climb Mt. Everest	*Junko Tabei (Japan)*
✶ First woman to climb Mt. Everest alone and without oxygen supplies	*Alison Hargreaves (Briton: May 13, 1995)*
✶ First Aeroplane to fly around the world without refuelling	*Voyager (Dec. 1986)*
✶ First test-tube Baby	*Louise Brown (UK; 1978)*
✶ First all-talking Film	*Jaz Singer (1927)*
✶ First Secretary-General of the UN	*Trygve Lie (Norway: 1946-53)*
✶ First woman President of the UN General Assembly	*Vijayalakshmi Pandit (India: 1953)*
✶ First woman to reach North Pole	*Ann Bancroft (1986)*
✶ First person to reach North Pole	*Robert Peary*
✶ First person to reach South Pole	*Amundsen (1911)*
✶ First woman to command Spacecraft in Space	*Ellin Collins*

SUPERLATIVES (WORLD)
(The Largest, Biggest, Smallest, Longest, Highest)

Airport	*Largest*	King Fahd International Airport, Dammam (Saudi Arabia)
Animal,	*Tallest*	Giraffe (Average height 6.09 m)
	Largest and Heaviest	Blue Whale (190 tonnes)
	Longest recorded	Boot lace Worm (55 m)
	Fastest	Cheetah (Approximately 100 km/hr)

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Bay,	*With max. shore line*	Hudson Bay (Canada: 12268 km)
	With maximum area	Bay of Bengal (India: 217 million hc)
Bridge,	*Highest*	Sidu River Bridge (China: 1627 ft)
Building,	*Tallest*	Burj Khalifa (Dubai, 818 meter)
Canal,	*Big ship (longest)*	Suez Canal (160 km)
	Busiest	Kiel Canal (North Sea)
Canyon/Gorge,	*Deepest*	Hells Canyon, Snake River (Idaho : 7900 ft)
	Largest	Grand Canyon (Colarado River; USA; 446 km)
Church,	*Largest*	Basilica of St. Peter (Vatican City Rome– Area 23000 sq.m.)
City,	*Largest in Area*	Jiuquan Gansu, China (Area 1,67,996 Sq km)
Continent,	*biggest*	Asia (30,928,605 km^2)
	Smallest	Australia Mainland (Area 8,426,635 km^2)
Country,	*Largest in Population*	China (over 138.5 crore)
	Largest in Area	Russia (17,075,000 sq. km)
	With largest electorate	India (over 90 crores)
	Smallest independent	State of Vatican City (109 acre)
	With most land frontiers	China (16)
Dam,	*Largest (concrete)*	Grand Coulee Dam (1272 m on Columbia River (Washington State, USA)
	Highest	Jinping-I (305 m)
Delta,	*Largest*	Sundarban's Ganga-Brahmaputra delta (1,05,000 sq. km)
Desert,	*Largest*	Sahara (N. Africa; maximum length 5,150 km EW; maximum width 3,200 km NS)
Diamond,	*Largest*	The Cullinan (3106 carats)
Dome,	*Largest*	Singapore National Stadium (310 m)
Epic,	*Longest*	Mahabharata
Fish,	*Largest fresh water*	Plabeuk (China, Laos and Thailand)
	Most abundant	Bristle mouth
	Most venomous	Stone Fish (Indo-Pacific Waters)
Film,	*Most Oscars*	Ben Hur (11 Oscars–1959); Titanic (11 Oscars–1998); The Lord of Rings : The Return of the King (11 Oscars—2003).
Fountain,	*Tallest*	King Fahd's Fountain (Jeddah, Saudi Arabia)
Fruit,	*Most nutritive*	Avocado (Vitamins A, C, E and Proteins; Central and South America)
	Least nutritive	Cucumber
Goldmine,	*Largest in area*	Grasberg Mines (Fapua, Indonesia)
Gulf,	*Largest*	Gulf of Mexico (1,544,000 sq. km)
Hotel,	*Tallest*	JW Marriott Marquis, Dubai (355 meter, 77 Floor)
	Largest (with most rooms)	Hotel Rossiya (Moscow; Russia; 12 storey; 3,200 rooms)
Island,	*Biggest*	Greenland (now known as Kalaatdlit Nunaat–2,175,000 sq km)
Lake,	*Largest*	Caspian Sea (Azerbaijan, Russia, Iran border: 37.18 lakh km^2)
	Deepest	Baikal (Siberia)
	Largest (fresh water)	Superior Lake (USA–Canada border: 82,350 km^2)
Library,	*Biggest*	United States Library of Congress (Washington D.C. founded in 1800, contains 101 million items)
	Biggest non-statutory	New York Public Library
Mountain,	*Highest peak*	Mt. Everest (8848 m; Nepal)
	Highest range	Himalayas, Asia (upto 4200 m)
	Greatest mountain range	Himalaya-Karakoram (96 out of 109 peaks over 7315 m are here)

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Museum,	*Largest*	American Museum of Natural History, New York
Ocean,	*Largest and Deepest*	The Pacific (Area: 166,240,000 km^2; Depth: 10,924 m)
Peninsula,	*Largest*	Arabia (3.25 million sq. km)
Park,	*Largest*	National Park of North-Eastern, Greenland (972000 km^2)
Places,	*Coldest (annual mean)*	Polus Nedostupnosti (Antarctica –58°C)
	Driest (annual mean)	Desierto de Atacame (near Calama; Chile; rainfall nil)
	Hottest (annual mean)	Dallol (Ethiopia; 34.4°C mean temperature)
	Rainiest (annual mean)	Mowsyrnam near Cherapunji (Meghalaya; India; 11873 mm)
	Windiest	The Commonwealth Bay (Gales reach 320 km/ph)
Planet,	*Biggest*	Jupiter (equatorial diameter 142984 km)
	Brightest, hottest and nearest to Earth	Venus
	Nearest to Sun	Mercury
	Most satellites	Saturn (82)
Plateau,	*Highest*	Tibetan Plateau (Central Asia: 4900 m)
Platform,	*Longest (rail)*	Gorakhpur (Uttar Pradesh; India, 1355.4 m. long)
Port,	*Largest*	Port of New York and New Jersey (USA)
Port,	*Busiest*	Rotterdam (Netherlands)
Railway Line,	*Longest*	Trans-Siberian Railway (Moscow-Nakhodka: 9438 km)
Railway Station,	*Largest*	Grand Central Terminal (New York City; 19 hc)
	Highest	Condor (Bolivia; 4786 m)
Religion,	*Oldest*	Hinduism
Religion,	*Largest*	Christianity
Rivers,	*Longest*	(i) Nile (6650 km) (ii) Amazon (6437 km)
Road,	*Longest*	Pan American Highway (from Alaska-Brasila: 24140 km)
Sea,	*Largest*	South China Sea (2,974,600 sq. km)
	Largest (inland)	Mediterranean
Stadium,	*Largest*	Strahov stadium at Prague (Czechoslovakia 240,000 spectators)
Star,	*Brightest*	Sirius A (also called Dog Star)
Swimming	*Longest*	English Channel
Telescope,	*Largest (radio)*	Five Hundred meter Apertune Spherical Telescope (FAST), China.
	Largest (solar)	Kitt Peak National Observatory, (Arizona; USA)
	Largest refractor	At Yerkes observatory (Wisconsin; USA; 18.9 m)
Temple,	*Largest*	Angkor Wat (Cambodia: 402 acres)
Tower,	*Tallest*	Tokyo Sky Tree (634 m.)
Train,	*Fastest*	Japan's magnetically levitated (magler) train (Speed over 500 km/hr)
Tunnel,	*Longest (railway)*	Gotthard Base Rail Tunnel (Switzerland; 57.1 km)
	Largest (road)	Laerdal, Norway (24.51 km)
Volcano	*Greatest concentration in*	Indonesia
	Highest (extinct)	Cerro Aconcagua (6960 m; Andes)
	Highest (dormant)	Volcan Llullaillaco (6723 m; Argentina-Chile)
	Highest (active)	Ojos del Salado (Chile-Argentina)
Waterfall,	*Highest*	Salto-Angel (in Venezuela on a branch of river Carrao, depth 807 m.)
	Largest	Khone Falls (Laos; width 10.8 km)
Zoo,	*Largest*	Etosha Reserve (Namibia; area 10 million hc approx.).

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CAPITAL & CURRENCIES

Country	Capital	Currency
✶ Afghanistan	Kabul	Afghani
✶ Albania	Tirana	Lek
✶ Algeria	Algiers	Dinar
✶ Angola	Luanda	New Kwanza
✶ Argentina	Buenos Aires	Peso
✶ Armenia	Yeravan	Dram
✶ Australia	Canberra	Dollar
✶ Austria	Vienna	Euro
✶ Azerbaijan	Baku	Manat
✶ Bahrain	Manama	Dinar
✶ Bangladesh	Dhaka	Taka
✶ Barbados	Bridgetown	Dollar
✶ Belarus	Minsk	Ruble
✶ Belgium	Brussels	Euro
✶ Benin	Porto Novo	Franc
✶ Bhutan	Thimphu	Ngultrum[1]
✶ Bolivia	La paz	Dollar
✶ Botswana	Gaborone	Pula
✶ Brazil	Brasilia	Real
✶ Bosnia Herzegovina	Sarajevo	Dinar
✶ Bulgaria	Sofia	Lev
✶ Cambodia	Phnom-Penh	Riel
✶ Canada	Ottawa	Dollar
✶ Chile	Santiago	Peso
✶ China	Beijing	Yuan
✶ Colombia	Bogota	Peso
✶ Congo	Brazzaville	Franc
✶ Croatia	Zagreb	Kuna
✶ Cuba	Havana	Peso
✶ Cyprus	Nicosia	Euro
✶ Czech Republic	Prague	Koruna
✶ Denmark	Copenhagen	Krone
✶ Ecuador	Quito	Sucre
✶ Egypt	Cairo	Pound
✶ Estonia	Tallinn	Euro
✶ Ethiopia	Addis Ababa	Birr
✶ Fiji	Suva	Dollar
✶ Finland	Helsinki	Euro
✶ France	Paris	Euro
✶ Georgia	Tbilisi	Lari
✶ Germany	Berlin	Euro
✶ Ghana	Accra	Cedi
✶ Greece	Athens	Euro
✶ Guatemala	Guatemala City	Quetzal
✶ Guyana	George Town	Dollar
✶ Hungary	Budapest	Forint
✶ Iceland	Reykjavik	Krona
✶ India	New Delhi	Rupee
✶ Indonesia	Jakarta	Rupiah
✶ Iran	Teheran	Rial
✶ Iraq	Baghdad	Dinar
✶ Ireland	Dublin	Euro
✶ Israel	Jerusalem	Shekel
✶ Italy	Rome	Euro
✶ Jamaica	Kingston	Dollar
✶ Japan	Tokyo	Yen
✶ Jordan	Amman	Dinar
✶ Kazakhstan	Akmola	Tenge
✶ Kenya	Nairobi	Shilling
✶ Korea (S)	Seoul	Won
✶ Korea (N)	Pyongyang	Won
✶ Kyrgyzstan	Bishkek	Som
✶ Kuwait	Kuwait City	Dinar
✶ Laos	Vientiane	Kip
✶ Latvia	Riga	Euro
✶ Lebanon	Beirut	Pound
✶ Liberia	Monrovia	Dollar
✶ Libya	Tripoli	Dinar
✶ Lithuania	Vilnius	Litas
✶ Luxembourg	Luxembourg	Euro
✶ Macedonia	Skopje	Dinar
✶ Malawi	Lilongwe	Kwacha
✶ Malaysia	Kuala Lumpur	Ringgit
✶ Maldives	Male	Rufiyaa
✶ Mali	Bamako	Franc
✶ Mauritius	Port Louis	Rupee
✶ Mexico	Mexico City	Peso
✶ Moldavia	Chisinau	Leu
✶ Mongolia	Ulan Bator	Tugrik
✶ Morocco	Rabat	Dirham
✶ Mozambique	Maputo	Metical
✶ Myanmar	Nay Pyi Taw	Kyat
✶ Namibia	Winohoek	Dollar
✶ Nepal	Kathmandu	Rupee
✶ Netherlands	Amsterdam	Euro
✶ New Zealand	Wellington	Dollar
✶ Nigeria	Abuja	Naira
✶ Norway	Oslo	Krone
✶ Oman	Muscat	Rial
✶ Pakistan	Islamabad	Rupee
✶ Panama	Panama City	Balboa
✶ Peru	Lima	New Sole
✶ Philippines	Manila	Peso
✶ Poland	Warsaw	Zloty

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Country	Capital	Currency
✶ Portugal	Lisbon	Euro
✶ Qatar	Doha	Riyal
✶ Romania	Bucharest	Leu
✶ Russia	Moscow	Ruble
✶ Saudi Arabia	Riyadh	Rial
✶ Senegal	Dakar	Franc
✶ Slovakia	Bratislava	Euro
✶ Spain	Madrid	Euro
✶ Sri Lanka	Colombo	Rupee
✶ Sudan	Khartoum	Dinar
✶ Suriname	Paramaribo	Guilder
✶ Sweden	Stockholm	Krona
✶ Switzerland	Berne	Swiss Francs
✶ Syria	Damascus	Pound
✶ South Africa	Capetown (Legislative) Pretoria *(Administrative)*	Rand
✶ Tadzhikistan	Dushanbe	Ruble

Country	Capital	Currency
✶ Taiwan	Taipei	Dollar
✶ Tanzania	Dodoma	Shilling
✶ Thailand	Bangkok	Baht
✶ Tunisia	Tunis	Dinar
✶ Turkey	Ankara	Lira
✶ Turkmania	Ashikabad	Manat
✶ Uganda	Kampala	Shilling
✶ Ukraine	Kiev	Hyrvnia
✶ United Arab Emirates	Abu Dhabi	Dirham
✶ U.K.	London	Pound Sterling
✶ U.S.A.	Washington	Dollar
✶ Uruguay	Montevideo	Peso
✶ Uzbekistan	Tashkent	Som
✶ Venezuela	Caracas	Bolivar
✶ Vietnam	Hanoi	Dong
✶ Yemen	Sana'a	Rial
✶ Zimbabwe	Harare	Dollar
✶ Congo (Zaire)	Kinshasa	Zaire
✶ Zambia	Lusaka	Kwacha

GEOGRAPHICAL EXPLORATIONS/DISCOVERIES

Place	Explorer/Discoverer	Nationality	Year
America	Christopher Columbus	Italy	1492
Hawaii Islands (Sandwich Islands)	Captain James Cook	England	1778
Newfoundland	John Cabot	England	1497
New Zealand	Abel Janszoon Tasman	Holland	1642
North Pole	Robert Peary	USA	1909
Sea Route to India (via Cape of Good Hope)	Vasco da Gama	Portugal	1498
South Pole	Roald Amundsen	Norway	1911

NATIONAL MONUMENTS OF SOME FAMOUS COUNTRIES

Monument	Country	Monument	Country
Great Wall of China	China	Pyramid (Giza)	Egypt
Taj Mahal (Agra)	India	Kinder Disk	Denmark
Emperial Palace (Tokyo)	Japan	Leaning Tower of Pisa	Italy
Opera House (Sydney)	Australia	Statue of Liberty (New York)	USA
Eiffel Tower (Paris)	France	Kremlin (Moscow)	Russia

INTELLIGENCE AGENCIES OF SOME PROMINENT COUNTRIES

Country	Intelligence Agency
✶ India	*Research & Analysis Wing (RAW), Intelligence Bureau (I.B.), Central Bureau of Investigation (C.B.I.)*
✶ Pakistan	*Inter Service Intelligence (I.S.I.)*
✶ U.S.A.	*Central Intelligence Agency (CIA), Federal Bureau of Investigation (FBI)*
✶ Britain	*Military Intelligence (M.I.)-5 and 6, Special Branch, Ultra, Joint Intelligence Organisation*

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✶ Israel	*Mosad*
✶ Egypt	*Mukhabarat*
✶ Japan	*Nicho*
✶ Russia	*K.G.B. (Komitel Gosudarstvennoy Bezopasnosty) (Committee for State Security)*
✶ Canada	*Security Intelligence Service (SIS)*
✶ S. Africa	*Bureau of State Security (BSS)*
✶ Iran	*Sabak*
✶ Iraq	*Al-Mukhabarat*
✶ Australia	*Australian Security and Intelligence Organisation (ASIO)*
✶ France	*S.D.E.C.E.*
✶ Spain	*C.E.S.I.D.*

MAJOR LANGUAGES OF THE WORLD AND THEIR SPEAKERS

Listing the languages spoken by approximately 1% of humankind (those spoken by more than 60,000,000 people), this table enumerates speakers of each tongue as a primary language.

Language	Speakers (millions)
✶ Chinese	1,298.6
✶ Spanish	442.4
✶ English	378.3
✶ Arabic	315.3
✶ Hindi	260.0
✶ Bengali	242.7
✶ Portuguese	222.7
✶ Russian	153.9
✶ Japanese	128.2
✶ Lahnda	118.2
✶ Punjabi (Western)	93
✶ Javanese	84
✶ Korean	77.2
✶ French	76.8
✶ German	76.0
✶ Telugu	74.8
✶ Turkish	78.5
✶ Marathi	71.8
✶ Urdu	69.2
✶ Vietnamese	68
✶ Tamil	66.7
✶ Italian	64.8
✶ Persian	61.5
✶ Malay	60.7

Source : The World Almanac 2019

IMPORTANT NEWS AGENCIES OF THE WORLD

Agency	Country
PTI, UNI, UNIVARTA	India
Antara	Indonesia
Tanjug	Serbia
Associated Press (AP)	America
Reuters, NAFEN	United Kingdom
Angence France Press (AFP)	France
TASS	Russia

NAME OF PARLIAMENTS OF SOME COUNTRIES

Country	Name of Parliament
Afghanistan	Shora
Argentina	National Congress
Australia	Federal Parliament
Austria	National Assembly
Bangladesh	Jatiya Sansad
India	Lok Sabha and Rajya Sabha
Bhutan	Tshogdu (National Assembly)
Britain	House of Commons and House of Lords
Canada	House of Commons and Senate
China	National People Congress
Denmark	Folketing

Country	Name of Parliament
Iran	Majlis (Islamic Consultative Assembly)
Israel	Knesset
Japan	Diet
Myanmar	Pyithu Hluttaw (People's Assembly)
Nepal	Rashtriya Panchayat
The Netherlands	States-General
Norway	Storting
Poland	Sejm
Russia	Federal Assembly (Council of the Federation and State Duma
South Africa	National Assembly and Senate

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Country	Name of Parliament
Spain	Cortes Generales
Sweden	Riksdag
Switzerland	Federal Assembly (Nationalrat and Standerat)
North Korea	Supreme People's Assembly
South Korea	National Assembly
U.S.A.	Congress (Senate and House of Representatives)
Ethiopia	Federal Council and House of Representatives
Iceland	Alpingi
Bulgaria	National Assembly
Cuba	National Assembly of People's Power

LARGEST AND SMALLEST COUNTRIES (Top 5)

Largest Country (Area-wise)	Largest Country (Population-wise)	Smallest Country (Area-wise)	Smallest Country (Population-wise)
Russia	China	Vatican City	Vatican City
Canada	India	Monaco	Tuvalu
China	USA	Nauru	Palau
United States	Indonesia	Tuvalu	San Marino
Brazil	Brazil	San Marino	Liechstein

RELIGIONS OF THE WORLD

Religion	Member	Percentage	Religion	Member	Percentage
Christianity	2.4 billion	33.0%	Buddhism	521 million	7.0%
Islam	1.7 billion	23.6%	Sikhism	25 million	0.36%
Hinduism	1.01 billion	14%			

NATIONAL EMBLEMS OF IMPORTANT COUNTRIES

Country	National Emblem	Country	National Emblem
America	Golden Rod	Australia	Kangaroo
Ireland	Shamrock	Italy	White Lily
Israel	Candelabrum	Iran	Rose
Canada	White Lily	Great Britain	Rose
Chile	Candor and Huemul	Germany	Corn Flower
Japan	Chrysanthemum	Zimbabwe	Zimbabwe Bird
Denmark	Beach	Turkey	Crescent and Star
The Netherlands	Lion	New Zealand	Kiwi, Fern Southern Cross
Norway	Lion	Nepal	Kukri
Pakistan	Crescent	Poland	Eagle
France	Lily	Belgium	Lion
Bangladesh	Water Lily	Mongolia	The Soyombo
Russia	Double headed eagle	Lebanon	Cedar Tree
Sudan	Secretary Bird	Syria	Eagle
India	Lioned Capital		

FIRST IN INDIA

✶ The first Indian to get the Nobel Prize for Literature	*Rabindra Nath Tagore*
✶ The first Indian to get the Nobel Prize for Physics	*C.V. Raman*
✶ The first Indian to get the Nobel Prize for Peace	*Mother Teresa*
✶ The first Indian to get the Nobel Prize for Economics	*Amartya Sen*
✶ The first Indian to get Special Oscar award (1992)	*Satyajit Ray*

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✶ The first and the last Indian Governor-General of free India	*C. Rajagopalachari*
✶ The first woman to become the Governor of a State	*Smt. Sarojini Naidu*
✶ The first Indian Chief of the Army Staff	*General K.M. Cariappa*
✶ The first ever woman to become the Chief Minister of a State	*Smt. Sucheta Kripalani*
✶ The first Indian woman President of UN General Assembly	*Smt. Vijaylakshmi Pandit*
✶ The first Indian to become the President of International Court of Justice	*Dr. Nagendra Singh*
✶ The first Indian woman to swim across the English Channel	*Ms. Aarti Saha*
✶ The first Indian girl to become Miss Universe	*Miss Sushmita Sen*
✶ The first Indian girl to become Miss World	*Rita Faria*
✶ The first Indian to swim across the English Channel	*Mihir Sen*
✶ The first Field Marshal	*S.H.F.J. Manekshaw*
✶ The first Indian recipient of Victoria Cross	*Khudadad Khan*
✶ The first Indian to conquer Mt. Everest	*Sherpa Tenzing (May 29, 1953)*
✶ The first Indian Cosmonaut (man)	*Rakesh Sharma (April 3, 1984)*
✶ The first Indian Cosmonaut (woman)	*Kalpana Chawla (Nov. 19, 1997)*
✶ The first woman to climb Mt. Everest	*Miss Bachendri Pal (May 23, 1984)*
✶ The first ICS	*Satyendranath Tagore*
✶ The first to address the UN General Assembly in Hindi	*Atal Bihari Vajpayee*
✶ The first Newspaper	*Bengal Gazette (Jan 27, 1780)*
✶ The first Postage Stamp issued	*In 1852*
✶ The first Telegraph line laid	*In 1851 (Calcutta-Diamond Harbour)*
✶ The first Railways run	*April 16, 1853 (Bombay-Thane)*
✶ The first Electric Train run	*1925 (Bombay-Kurla)*
✶ The first Atomic Power Station	*Tarapore (Maharashtra)*
✶ The first passenger-cum-cargo ship made in India	*Harshavardhan*
✶ The first Satellite	*Aryabhatta (1975)*
✶ The first President of the Indian National Congress	*W.C. Banerjee*
✶ The first President of Indian Republic	*Dr. Rajendra Prasad*
✶ The first woman judge of the Supreme Court	*Ms Fatima Bibi*
✶ The first to climb Everest without oxygen	*Phu Dorjee (1987)*
✶ The first film (movie)	*Raja Harishchandra*
✶ The first film (talkie)	*Alam Ara*
✶ The first Metro Railway	*Calcutta Metro Railway*
✶ The first Test-tube baby, scientifically documented	*Born on August 6, 1986 at K.E.M. Hospital, Bombay*
✶ The first TV Centre	*At Delhi*
✶ The first Indian to get an Oscar	*Bhanu Athaiya*
✶ The first woman pilot in IAF	*Ms Harita Kaur Deol*
✶ The first woman to get Olympic Medal	*Karnam Malleswari*
✶ The first woman Foreign Secretary	*Chokila Iyer*
✶ First Chief of Defence Staff (CDS)	*General Bipin Rawat*

SUPERLATIVES (INDIA)

Highest, Biggest, Largest and Longest in India

✶ Award for Gallantry, highest	*Param Vir Chakra*
✶ Award, highest civilian	*Bharat Ratna*
✶ Bank, with largest number of branches	*State Bank of India*

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✶ Road Bridge, Longest	*Bhupen Hazarika Bridge, Assam (9.15 km)*
✶ Road and Rail Bridge, Longest	*Bogibeel Bridge, Brahmaputra River, Assam*
✶ Cattle Fair, Largest	*Sonepur (Bihar)*
✶ City, Most Populous	*Mumbai metropolis*
✶ Corridor, Longest	*Rameshwaram Temple corridor (4,000 ft.)*
✶ Desert, Largest	*Thar (Rajasthan)*
✶ Dam, Longest	*Hirakud Dam (Odisha)*
✶ Delta, Largest	*Sunderban's Delta*
✶ Dome, Largest	*Gol Gumbaj (Bijapur)*
✶ Dam, Highest	*Tehri Dam (260 m)*
✶ Gateway, Highest	*Buland Darwaja at Fatehpur Sikri (176 ft.)*
✶ Fresh Water Lake, Largest	*Wular Lake (Kashmir)*
✶ Literacy, Highest	*Kerala (94%)*
✶ Museum, Largest	*Indian Museum (Kolkata)*
✶ Mosque, Biggest	*Jama Masjid (Delhi)*
✶ Peak, Highest**	*K-2 (Pak-Occupied Kashmir)*
✶ Platform, Longest	*At Gorakhpur, NE Railway (1335.4 mtrs)*
✶ Railway Bridge, longest	*Vembanad Bridge, Kerala (4.6 km)*
✶ River, Longest***	*The Ganges (2525 Km)*
✶ Rainfall, Highest (annual mean)	*Mowsynram near Cherrapunji (1178 cm)*
✶ Road Longest	*Grand Trunk Road (1,500 miles)*
✶ State, with maximum forest cover	*Madhya Pradesh*
✶ State, with maximum density of population	*Bihar*
✶ Telescope, Largest in Asia	*Vainu Bappu Telescope (at Kavalur: Chennai) 2.34m*
✶ Tunnel, Longest (Road)	*Chenani-Nashri Tunnel (9.28 kms, J & K)*
✶ Tunnel, Longest (Railway)	*Qazigund to Banihal (11.21 kms) Jammu & Kashmir.*
✶ Tallest Minaret	*Qutub Minar (Delhi 72.5 m.)*
✶ Waterfall, Highest	*Gersoppa Waterfall (Karnataka: 960 ft.)*
✶ Zoo, Largest	*Zoological Gardens (Kolkata)*

** *Highest peak in the world is Mount Everest, which is in Nepal. K-2 is the second highest peak in the world. It is 8,611 metres high.*
*** *Indus and Brahmaputra (each 2900 km). Both of them, however, cover a long distance outside India.*

TABLE OF PRECEDENCE

1. President
2. Vice-President
3. Prime Minister
4. Governors of States within their respective states
5. Former Presidents

5A. Deputy Prime Minister

6. Chief Justice of India, Speaker of Lok Sabha
7. Cabinet Ministers of the Union, Chief Ministers of States within their respective States
   Deputy Chairman NITI Aayog, former Prime Ministers
   Leaders of opposition in Rajya Sabha and Lok Sabha

7A. Holders of the Bharat Ratna Decoration

8. Ambassadors Extraordinary and Plenipotentiary and High Commissioners of Commonwealth Countries accredited to India, Chief Ministers of States outside their respective States
9. Judges of the Supreme Court
10. Deputy Chairman Rajya Sabha, Deputy Chief Minister of States, Deputy Speaker Lok Sabha, Members of the NITI Aayog, Minister of State of the Union and Other Minister in the Ministry of Defence.

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BOOKS AND AUTHORS

FOREIGN

Book	Author
✶ As You Like It	*William Shakespeare*
✶ A Tale of Two Cities	*Charles Dickens*
✶ Ben Hur	*Lewis Wallace*
✶ Das Kapital	*Karl Marx*
✶ David Copperfield	*Charles Dickens*
✶ Hamlet	*William Shakespeare*
✶ Iliad	*Homer*
✶ Inferno	*A. Dante*
✶ In Memoriam	*Lord Tennyson*
✶ Ivanhoe	*Walter Scott*
✶ Julius Caesar	*William Shakespeare*
✶ Lady Chatterley's Lover	*D.H. Lawrence*
✶ Lajja	*Taslima Nasreen*
✶ Les Miserable	*Victor Hugo*
✶ Leviathan	*Thomas Hobbes*
✶ Lolita	*V. Nobokov*
✶ Lycidas	*John Milton*
✶ Mein Kampf	*Adolf Hitler*
✶ Moor's Last Sigh	*Salman Rushdie*
✶ Mother	*Maxim Gorky*
✶ Mother India	*Katherine Mayo*
✶ Nana	*Emile Zola*
✶ Odyssey	*Homer*
✶ Origin of Species	*Charles Darwin*
✶ Othello	*William Shakespeare*
✶ Paradise Lost	*John Milton*
✶ Paradise Regained	*John Milton*
✶ Path to Power	*Margaret Thatcher*
✶ Pickwick Papers	*Charles Dickens*
✶ Razor's Edge	*Somerset Maugham*
✶ Republic	*Plato*
✶ The Tempest	*William Shakespeare*
✶ Time Machine	*H.G. Wells*
✶ Tom Sawyer	*Mark Twain*
✶ Treasure Island	*R.L. Stevenson*
✶ Twelfth Night	*William Shakespeare*
✶ Unto This Last	*John Ruskin*
✶ Utopia	*Thomas More*
✶ Wealth of Nations	*Adam Smith*
✶ Wonder that was India	*A.L. Basham*

INDIAN

Book	Author
✶ Ain-i-Akbari	*Abul Fazal*
✶ Anand Math	*Bankim Chandra Chatterjee*
✶ Arthashastra	*Kautilya*
✶ A Suitable Boy	*Vikram Seth*
✶ Bhagwat Gita	*Ved Vyas*
✶ Chidambara	*Sumitranandan Pant*
✶ Devdas	*Sarat Chandra Chatterjee*
✶ Discovery of India	*Jawaharlal Nehru*
✶ Ganadevata	*Tarashankar Bandopadhyaya*
✶ Geet Govind	*Jaya Dev*
✶ Geetanjali	*R. N. Tagore*
✶ Glimpses of World History	*Jawaharlal Nehru*
✶ Godaan	*Prem Chand*
✶ Gul-e-Nagma	*Firaq Gorakhpuri*
✶ Harsh Charita	*Bana Bhatta*
✶ India Divided	*Dr. Rajendra Prasad*
✶ Justice of Peace ke Aansu	Janardan Prasad Singh
✶ The Judgement	*Kuldip Nayyar*
✶ Kadambari	*Bana Bhatta*
✶ Kagaz Te Kanwas	*Amrita Pritam*
✶ Kamayani	*Jai Shankar Prasad*
✶ Kitni Nawon Mein Kitni Bar	*S. H. Vatsyayan*
✶ Kumar Sambhav	*Kalidas*
✶ Mahabharata	*Ved Vyas*
✶ Malgudi Days	*R.K. Narayan*
✶ Meghdoot	*Kalidas*
✶ Mritunjaya	*B.K. Bhattacharya*
✶ Mudrarakshasa	*Vishakhadatta*
✶ Prison Diary	*Jaya Prakash Narayan*
✶ Raghuvansha	*Kalidas*
✶ Rajtarangini	*Kalhana*
✶ Ramayana	*Balmiki*
✶ Ramcharit Manas	*Tulsidas*
✶ Rukh Te Rishi	*Harbhajan Singh*
✶ Satyarth Prakash	*Swami Dayanand*
✶ Sur Sagar	*Surdas*
✶ The Guide	*R.K. Narayan*

IMPORTANT DATES AND DAYS OF THE YEAR

✶ **JANUARY**

5-11 Road Safety Week
12 National Youth Day
15 Army Day
15-21 Pin Code Week
23 National Day of Patriotism
26 Republic Day
30 Martyr's Day

✶ **FEBRUARY**

1-14 Oil Conservation Fortnight

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14 Valentine's Day

✶ **MARCH**

4 National Safety Day
8 International Women's Day
15 Consumers' Day
16 Immunisation Day
21 World Forest Day
22 World Day for Water
24 World Meteorological Day
1-7 Preservation of Blindness Week

✶ **APRIL**

7 World Health Day
7-13 Handloom Week
14-20 Fire Service Week
18 World Heritage Day
22 World Earth Day

✶ **MAY**

1 May Day
5 National Labour Day
8 World Red Cross Day
11 National Technology Day
15 International Day of the Family
17 World Telecommunication Day
24 Commonwealth Day
31 World No-Tobacco Day

✶ **JUNE**

5 World Environment Day
21 World Yoga Day
26 International Day against Drug Abuse and Illicit Trafficking

✶ **JULY**

11 World Population Day

✶ **AUGUST**

1-7 World Breast feeding Week
10 Sanskrit Divas
15 Independence Day
20 Sadbhavana Divas

✶ **SEPTEMBER**

1-7 National Nutrition Week
5 Teachers' Day
8 International Literary Day
14 Hindi Diwas
23 World Deaf Day
27 World Tourism Day

✶ **OCTOBER**

2 Gandhi Jayanti
International Day of Non Violence
Anti-Leprosy Day
4 World Animal Day
6 World Habitat Day *(Ist Monday)*
8 Indian Air Force Day
14 World Standard Day
15 International Day of Rural Women
16 World Food Day
24 United Nations Day
27 Infantry Day
28 World Thrift Day
31 Anti-Terrorism Day

✶ **NOVEMBER**

2 All Saints Day
14 Children's Day
15-21 National Cooperative Week
19-25 Quami Ekta Week
20 Child Rights Day
26 Constitution Day

✶ **DECEMBER**

1 World AIDS Day
3 World Day for the Disabled
4 Naval Day
7 Flag Day
8 SMRC Day
10 Human Rights Day
14 National Energy Conservation Day

INDIAN DEFENCE

- The Supreme Command of the Armed Forces is vested in the hands of the President of the Country.
- The responsibility for national defence, however, rests with the Cabinet. All important questions having a bearing on defence are decided by the Cabinet Committee on Political Affairs, which is presided over by the Prime Minister.
- The Defence Minister is responsible to Parliament for all matters concerning the Defence Services.
- All the administrative and operational control of Armed Forces are exercised by the Ministry of Defence. The three services—Army, Navy and Air Force function through their respective service head-quarters headed by the chief of Staff.
- The post of Chief of Defence Staff (CDS) was created in 2019.

Indian Army Commands

Command	*HQ Location*
Eastern Command	Kolkata
Western Command	Chandigarh
Northern Command	Udhampur
Southern Command	Pune
Central Command	Lucknow
Training Command	Shimla
South-Western Command	Jaipur

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Indian Air Force Commands

Command	*HQ Location*
Western Air Command	New Delhi
Sout-Western Air Command	Gandhinagar
Central Air Command	Allahabad
Eastern Air Command	Shillong
Southern Air Command	Thiruvananthapuram
Training Command	Bengaluru

Indian Navy Commands

Command	*HQ Location*
Eastern Naval Command	Vishakhapatnam
Western Naval Command	Mumbai
Southern Naval Command	Cochin

Commissioned Ranks in Defence Services

Army	*Navy*	*Air Force*
General	Admiral	Air Chief Marshal
Lieutenant-General	Vice-Admiral	Air Marshal
Major-General	Rear-Admiral	Air Vice-Marshal
Brigadier	Commodor	Air Commodor
Colonel	Captain	Group Captain
Lieutenant-Colonel	Commander	Wing Commander
Major	Lt.Commander	Squadron Leader
Captain	Lieutenant	Flight Lieutenant
Lieutenant	Sub-Lieutenant	Flying Officer

Internal Security Organisations of India

S. No.	*Name of Organisation*	*Year of Creation*	*Headquarters*
1.	Assam Rifles (A.R.)	1835	Shillong
2.	Central Reserve Police Force (CRPF)	1939	New Delhi
3.	Territorial Army	1948	In different States
4.	Indo-Tibetan Border Police	1962	New Delhi
5.	Home Guard	1962	In different States
6.	Coast Guard	1978	New Delhi
7.	Border Security Force (B.S.F.)	1965	New Delhi
8.	Central Industrial Security Force (CISF)	1969	New Delhi
9.	National Security Guard	1984	New Delhi
10.	Police	—	In different States

Army Institutes

1.	Sainik Schools	33 places in India
2.	Rashtriya Indian Military College (prepare for entrance to N.D.A.)	Dehradun
3.	National Defence Academy (three services)	Khadakwasla, Pune
4.	Indian Military Academy (Army)	Dehradun
5.	Officers Training Academy (3 services) Short Courses	Chennai
6.	National Defence College	New Delhi
7.	The College of Combat	Mhow
8.	The College of Military Engineering	Kirkee
9.	Military College of Telecommunication Engineering	Mhow
10.	The Armoured Corps Centre and School	Ahmed Nagar
11.	The School Artillery	Deolali
12.	The Infantry School	Mhow and Belgaum
13.	College of Material Management	Jabalpur

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Air Force Institutions

✶ Air Force Academy	Hyderabad	✶ Helicopter Training School	Hakimpet
✶ Flying Instructors School	Tambaram, Chennai	✶ The College of Air Warfare	Secunderabad
✶ Air Force Administrative College	Coimbatore	✶ Air Force Technical College	Jalahalli

UNITED NATIONS ORGANISATION (UNO)

- The United Nations (UN) is an association of states which have pledged themselves to maintain international peace and security and cooperate in solving international political, economic, social cultural and humanitarian problems towards achieving this end.
- Trygve Lie of Norway (1946-52) was the first Secretary-General of the UN.
- ***Origin:*** UN Charter was signed by 50 members on June 26, 1945. Poland signed the charter later to become one of the original 51 member-states. It officially came into existence on October 24, 1945.
- ***UN Charter:*** The Charter is the Constitution of the UNO and contains its aims and objectives and rules and regulations for its functioning.
- ***Aims and Objectives:*** They are security, welfare and human rights.
- ***Headquarters:*** New York.
- ***Flag:*** The flag is light blue in colour, and emblazoned in white, in its centre is the UN symbol—a polar map of world embraced by twin olive branches open at the top.
- ***Official Languages:*** The official languages of the UN are: English, French, Chinese, Russian, Arabic and Spanish. However, working languages are English and French only.
- ***Present Membership:*** At present 193 countries are members of the UNO. South Sudan is the latest entrant to this world organisation.
- ***Main Organs of the UNO:*** There are six main organs:
  1. General Assembly
  2. Security Council
  3. Economic and Social Council
  4. Trusteeship Council
  5. International Court of Justice, and
  6. Secretariat.

1. *General Assembly:* It consists of representative of all members of the UN. Each member country has only one vote. It meets once a year and passes UN Budget. It is the main place for discussions and policy making in the UN.
2. *Security Council:* It is the Executive body of the UN and is mainly responsible for maintaining international peace and security. It has 15 members, 5 of which (USA, UK, France, Russia and China) are permanent members. The 10 non-permanent members are elected by General Assembly for two-year term and are not eligible for immediate re-election.
3. *Economic and Social Council:* It has 54 members elected by General Assembly.
4. *Trusteeship Council:* It looks after interest of the people in areas not yet independent and leads them towards self-government.
5. *International Court of Justice:* It has 15 judges, no two of whom may be nationals of the same state. They are elected by General Assembly and Security Council for a term of 9 years. The Court elects its President and Vice-President for a 3-year term.
6. *Secretariat:* It is the Secretariat of the UN and is headed by the Secretary General.

Some Important UN Agencies

UN Agencies	Headquarters	Year of Establishment
✶ United Nations Organisations (U.N.O.)	New York	1945
✶ International Monetary Fund (I.M.F.)	Washington	1945
✶ World Health Organisation (W.H.O.)	Geneva	1948
✶ Food & Agricultural Organisation (FAO)	Rome	1943
✶ International Labour Organisation (ILO)	Geneva	1919
✶ UNESCO	Paris	1946
✶ Universal Postal Union (UPU)	Berne	1874
✶ UNIDO	Vienna	1967
✶ International Atomic Energy Agency (IAEA)	Vienna	1957

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✶ United Nations Development Programme (UNDP)	New York	1965
✶ UNICEF	New York	1946
✶ International Maritime Organisation (IMO)	London	1948
✶ World Meteorological Organisation (WMO)	Geneva	1951
✶ International Telecommunication Union (ITU)	Geneva	1947
✶ World Trade Organisation (WTO)	Geneva	1995
✶ International Development Association (IDA)	Washington D.C.	1960
✶ World Intellectual Property Organisation (WIPO)	Geneva	1967

Famous International Organisations

International Organisations	Headquarters	Year of Establishment
✶ International Court of Justice	The Hague	1945
✶ International Civil Aviation Organisation (ICAO)	Montreal	1947
✶ International Finance Corporation (IFC)	Washington	1956
✶ Arab League	Cairo	1945
✶ Commonwealth of Nations	London	1931
✶ International Bank for Reconstruction and Development (IBRD)	Washington D.C.	1944
✶ Organisation of Islamic Cooperation (OIC)	Jeddah (Saudi Arabia)	1971
✶ European Economic Community (EEC)	Geneva	1957
✶ Red Cross	Geneva	1863
✶ Interpol	Lyons	1923
✶ Asian Development Bank (ADB)	Manila	1966
✶ North Atlantic Treaty Organisation (NATO)	Brussels	1949
✶ Association of South East Asian Nations (ASEAN)	Jakarta	1967
✶ South Asian Association for Regional Cooperation (SAARC)	Kathmandu	1985
✶ Asia-Pacific Economic Cooperation (APEC)	Singapore	1989
✶ Organisation for Economic Cooperation and Development (OECD)	Paris	1961
✶ Organisation of Petroleum Exporting Countries (OPEC)	Vienna	1960
✶ Commonwealth of Independent States (CIS)	Minsk	1991
✶ International Olympic Committee (IOC)	Switzerland	1894
✶ European Union (EU)	Brussels	Changed form of EEC Established in 1958
✶ Amnesty International (AI)	London	1961
✶ Shanghai Cooperation Organisation (SCO)	Beijing	2001
✶ BRICS Development Bank	Shanghai	2014

AWARDS AND HONOURS

NATIONAL AWARDS

BHARAT RATANA

- Bharat Ratna is India's highest Civilian Award. It was first awarded in 1954.
- The actual award is designed in the shape of a *peepal* leaf with Bharat Ratna inscribed in Devanagri script in the Sun Figure.
- This is India's highest civilian award. It is given for exceptional work on art, literature, science and recognition of public service of the highest order.
- The emblem, the Sun and the rim are of platinum. The inscriptions are in burnished bronze.
- Government servants are not eligible for it. The table shows the recipients of the award:

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Bharat Ratna Award Winners

1.	Dr. S. Radhakrishnan	1954
2.	C. Rajagopalachari	1954
3.	Dr. C.V. Raman	1954
4.	Dr. Bhagwan Das	1955
5.	Dr. M. Visvesvaraya	1955
6.	Jawahar Lal Nehru	1955
7.	Govind Ballabh Pant	1957
8.	Dr. D.K. Karve	1958
9.	Dr. Bidhan Chandra Roy	1961
10.	Purushottam Das Tandon	1961
11.	Dr. Rajendra Prasad	1962
12.	Dr. Zakir Hussain	1963
13.	Dr. Pandurang Vaman Kane	1963
14.	Lal Bahadur Shastri	1966
15.	Indira Gandhi	1971
16.	V.V. Giri	1975
17.	K. Kamraj	1976
18.	Mother Teresa	1980
19.	Acharya Vinoba Bhave	1983
20.	Khan Abdul Ghaffar Khan	1987
21.	M.G. Ramachandran	1988
22.	Dr. B.R. Ambedkar	1990
23.	Dr. Nelson R. Mandela	1990
24.	Rajiv Gandhi	1991
25.	Sardar Vallabhbhai Patel	1991
26.	Morarji R. Desai	1991
27.	Maulana Abul Kalam Azad	1992
28.	Jehangir Ratanji Dadabhai Tata	1992
29.	Satyajit Roy	1992
30.	Shri Gulzari Lal Nanda	1997
31.	Mrs. Aruna Asaf Ali	1997
32.	Dr. A.P.J. Abdul Kalam	1998
33.	M.S. Subbalakshmi	1998
34.	C. Subramaniam	1998
35.	Jaya Prakash Narayan	1999
36.	Prof. Amartya Sen	1999
37.	Pt. Ravi Shankar	1999
38.	Gopinath Bardoloi	1999
39.	Lata Mangeshkar	2001
40.	Bismillah Khan	2001
41.	Bhimsen Joshi	2009
42.	C.N.R. Rao	2014
43.	Sachin Tendulkar	2014
44.	Pt. Madan Mohan Malaviya	2015
45.	Atal Bihari Vajpayee	2015
46.	Pranab Mukherjee	2019
47.	Bhupen Hazarika	2019
48.	Nanaji Deshmukh	2019

REPUBLIC DAY AWARDS

Padma Awards

They fall in line after the Bharat Ratna. They are also discontinued in 1977 along with the Bharat Ratna and award was started again in 1980.

There are three Padma Awards:

- ***Padma Vibhushan:*** This award is given for exceptional and distinguished service in any field, including service rendered by Govt. servants.
- ***Padma Bhushan:*** This award is given for distinguished service of a high order in any field, including service rendered by Govt. servants.
- ***Padma Shri:*** This award is given for distinguished service in any field, including service rendered by Government servants.

Gallantry Awards

- ***Param Vir Chakra:*** The highest award for bravery or some daring and pre-eminent act of valour or self-sacrifice in the presence of the enemy, whether on land, at sea or in the air.
- ***Mahavir Chakra:*** It is the second highest decoration and is awarded for acts of conspicuous gallantry in the presence of the enemy, whether on land, at sea or in the air.
- ***Vir Chakra:*** It is the third in order of awards given for acts of gallantry in the presence of enemy, whether on land, at sea or in the air.
- ***Ashok Chakra:*** This medal is awarded for the most conspicuous bravery or some daring or pre-eminent act of valour or self-sacrifice on land, at sea or in the air but not in the presence of enemy.
- ***Vishishta Sewa Medal:*** It is awarded to personnel of all the three Services in class I, II and III in recognition of distinguished service of the "most exceptional" and "exceptional" and a "high" order respectively. Prefixes Parma and Ati are added before first two categories of medals respectively.
- ***Jeewan Raksha Padak:*** Awarded for meritorious acts or a series of acts of a human nature displayed in saving life from drowning, fire and rescue operations in mines etc.

OTHER NATIONAL AWARDS

SAHITYA AKADEMI AWARDS

- These prizes are awarded annually to the authors of the most outstanding books of literary merit published in each of the 24 languages recognised by the Akademi.
- There are also two awards for Sanskrit and English. The award, in form of a casket containing an inscribed copper plate and a cheque of ₹ 1 lakh is given to the author or his/her heir.

DADA SAHEB PHALKE AWARD

- The award carries a cash prize of ₹ 10 lakh, a Shawl and Swarna Kamal.
- Mrs Devika Rani Roerich was the first person to receive Dadasaheb Phalke Award in 1969.

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- The award for 2019 has been given to bollywood actor Rajinikanth.

BHARATIYA JNANPITH AWARD

- Instituted in 22nd May, 1961, carries a cash prize of ₹ 11 lakh, a citation and a bronze replica of Vagdevi (Saraswati).
- Instituted by a literary organisation in India.

SARASWATI SAMMAN

- Given for outstanding literary works, value ₹ 15 lakh.

KALINGA PRIZE

- This award is given each year by the UNESCO and founded by former Odisha Chief Minister late Shri Biju Patnaik for popularisation of science.

INTERNATIONAL AWARDS

NOBEL PRIZES

- These Prizes were instituted in 1901 by a Swedish scientist, Dr. Alfred Nobel; the discoverer of Dynamite.
- Six prizes are awarded annually for (i) Chemistry, (ii) Physics, (iii) Medicine, (iv) Literature, (v) Peace and (vi) Economics —started since 1969.
- Indians Honoured with Nobel Prize: So far, following Indians have been honoured with these prizes. Their names are (*i*) Rabindra Nath Tagore for Literature, for his book 'Gitanjali', in 1913, (*ii*) Dr. C.V. Raman for Physics in 1930, for his discovery of 'Raman Effect', (*iii*) Mother Teresa for Peace in 1979, (*iv*) Prof. Amartya Sen in 1998 for Economics and (*v*) Kailash Satyarthi for Peace in 2014. In addition, four non-resident Indians have also been awarded the Nobel Prize. They are: (*i*) Hargobind Khurana for Medicine in 1968, (*ii*) Subramanian Chandrasekhar for Physics in 1983, (*iii*) Venkatraman Ramkrishnan for Chemistry in 2009, (*iv*) Abhijit Vinayak Banerjee for Economics in 2019.

GANDHI PEACE PRIZE

- The government instituted this ₹ 1 crore prize on the lines of the Nobel Peace Prize in 1995.
- It is the highest Civilian International award by the Govt. of India.

MAN BOOKER INTERNATIONAL PRIZE 2021

- South African novelist and writer Damon Galgut was on November 3, 2021 awarded the prestigious Booker Prize for the year 2021 for his well-acclaimed novel 'The Promise', receiving £ 50,000. He is the third South African to win the prize, after J.M. Coetzee and Nadine Gordimer.

INDIRA GANDHI PRIZE FOR PEACE, DISARMAMENT AND DEVELOPMENT

- The award was instituted in the memory of Mrs. Indira Gandhi to foster creative cooperation among nations of the world.

Highest Honours of Some Countries

Country	*Highest Honour*
India	Bharat Ratna
Pakistan	Nishan-e-Pakistan
Kuwait	Mubarak-Al-kabir Medal
Saudi Arabia	Shah Abdul Aziz Medal
Argentina	The Order of Sona Martin
Nicaragua	Augusto-Caesar Sandino Order
Vietnam	The Order of the Golden Star
Hungary	The Order of Banner
Britain	Member of British Empire, Victoria Cross
Japan	Order of Moulovenice Sun
Denmark	Order of Diana Brog
France	Legend of Honour
America	Presidential Medal of Freedom
Germany	Pore Lee Merit Iron Cross
The Netherlands	Netherlands Lion

SPORTS

OLYMPICS

- First of all these games were held by the Greeks in 776 B.C. on Mount Olympus in honour of the Greek God Zeus. In this way, the history of Olympic Games is about twenty eight hundred years old. These games continued to be held every four years until 394 A.D. when these games were stopped by a royal order of the emperor of Rome.
- The modern Olympic Games which started in Athens in 1896, are the result of the devotion and dedication of a French educator Baron Pierre de Coubertin and the first Olympic meet in the modern series was held in 1896 in Athens, the Capital of Greece. Since then, they are being held every four years except for breaks during world wars.
- The Olympic flag is white in colour with five coloured rings, each ring symbolic of a continent. Summer as well as Winter Olympics are held in the same year.
- The 2020 Olympic Games was held at Tokyo in 2021.
- The official Olympic Motto is *Citius, Altius*, *Swifter, Higher, Stronger*. The Head Office of International Olympic Committee (IOC) is at Lausanne (Switzerland).

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COMMONWEALTH GAMES

- The Commonwealth Games are held every four years, in the year in which Asian Games are held. All the Commonwealth Countries (former colonies of Britain) can take part in it.
- The first Commonwealth Games were held in 1930 at Hamilton (Canada).
- There are currently 54 members of the Commonwealth of Nations, and 71 teams participated in the games.
- The 2018 Commonwealth Games officially known as the XXI Commonwealth Games or Gold Coast 2018, which is held in Gold Coast, Queensland, Australia, between 4 to 15 April 2018.

ASIAN GAMES

- After the Second World War, most of the Asian Countries gained independence. On the lines of Olympic Games, Asian Games were planned every four years.
- India hosted the first Asian Games in 1951.

WORLD CUP CRICKET

- The first Cricket World Cup was organised in England in 1975. A separate women's Cricket World Cup has been held every 4 years since 1973.

List of Cricket World Cup

Year	*Venue*	*Winner/Runner*
1975	England	*West Indies beat Australia*
1979	England	*West Indies beat England*
1983	England	*India beat West Indies*
1987	India & Pakistan	*Australia beat England*
1992	Australia	*Pakistan beat England*
1996	India, Pakistan & Sri Lanka	*Sri Lanka beat Australia*
1999	England	*Australia beat Pakistan*
2003	South Africa	*Australia beat India*
2007	West Indies	*Australia beat Sri Lanka*
2011	India, Sri Lanka, Bangladesh	*India beat Sri Lanka*
2015	Australia, New Zealand	*Australia beat New Zealand*
2019	England	*England beat New Zealand*
2023	India	*(to be held)*

HOCKEY WORLD CUP

- The first Hockey World Cup was organised in Barcelona (Spain) in 1971. Women's Hockey World Cup has been held since 1974.

FOOTBALL WORLD CUP

- The Football World Cup is organised by FIFA (Federation of International Football Association). The World Cup is called 'Jules Rimet Cup' named after the name of FIFA President Jules Rimet. The first Football World Cup was organised in Uruguay in 1930.
- In 1942 and 1946, the Football World Cup was not played due to World War II.
- Brazil is the only nation to have participated in every World Cup so far. The 2018 Football World Cup held in Russia. France on July 15, 2018 clinched their second FIFA World Cup title, beating Croatia 4-2 in the highest-scoring final since 1996.

IMPORTANT CUPS & TROPHIES

International

- *American Cup* : Yacht Racing
- *Ashes* : Cricket
- *Davis Cup* : Lawn Tennis
- *Derby* : Horse Race
- *Grand National* : Horse Streple Chase Race
- *Jules Rimet Trophy* : World Soccer Cup
- *King's Cup* : Air Races
- *Merdeka Cup* : Football
- *Swaythling Cup* : Table Tennis (Men)
- *Ryder Cup* : Golf
- *Thomas Cup* : Badminton
- *U. Thant Cup* : Tennis
- *Walker Cup* : Golf
- *Wightman Cup* : Lawn Tennis
- *Rothman's Trophy* : Cricket
- *European Champions Cup* : Football
- *Grand Prix* : Table Tennis
- *Edgbaston Cup* : Lawn Tennis
- *Grand Prix* : Lawn Tennis

National

- *Agha Khan Cup* : Hockey
- *Beighton Cup* : Hockey
- *Bombay Gold Cup* : Hockey
- *C.K. Naydu Trophy* : Cricket
- *Deodhar Trophy* : Cricket

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- *Duleep Trophy* : Cricket
- *Durand Cup* : Football
- *Dhyan Chand Trophy* : Hockey
- *Dr. B.C. Roy Trophy* : Football (Junior)
- *Ezra Cup* : Polo
- *Guru Nanak Cup* : Hockey
- *Holkar Trophy* : Bridge
- *Irani Trophy* : Cricket
- *Indira Gold Cup* : Hockey
- *Murugappa Gold Cup* : Hockey
- *Nehru Trophy* : Hockey
- *Nixan Gold Cup* : Football
- *Rani Jhansi Trophy* : Cricket
- *Ranji Trophy* : Cricket
- *Rangaswami Cup* : Hockey
- *Ramanujan Trophy* : Table Tennis
- *Rene Frank Trophy* : Hockey
- *Rohinton Baria Trophy* : Cricket
- *Rovers Cup* : Football
- *Santosh Trophy* : Football
- *Subroto Cup* : Football

SPORTS TERMS

- ***Badminton:*** Mixed doubles; Deuce; Drop; Smash; Let; Foot work; Setting.
- ***Base Ball:*** Pitcher; Put out, Strike; Home; Bunt.
- ***Billiards:*** Cue; Jigger; Pot; Break; In Baulk; In Off; Cannons.
- ***Boxing:*** Upper cut; Round; Punch; Bout; Knock down; Hitting below the belt; Ring.
- ***Bridge:*** Finesse; Dummy; Revoke; Grand Slam; Little Slam; No Trump; Rubber.
- ***Chess:*** Bishop, Gambit; Checkmate; Stalemate.
- ***Cricket:*** L.B.W. (leg before wicket); Creases, Popping-creases; Stumped; Bye; Leg-Bye; Googly; Hattrick; Maiden over; Drive; Bowling; Duck; Follow-on; No ball; Leg Break; Silly point; Cover point; Hit-wicket; Late-cut; Slip; Off-spinner; In-swing.
- ***Football:*** Off Side; Block; Drop-kick; Penalty-kick (or goal kick); Corner-kick; Free-kick; Dribble; Thrown-in; Foul.
- ***Golf:*** Boggy; Foursome; Stymic; Tee; Put; Hole; Niblic; Caddie; Links; The green; Bunker.
- ***Hockey:*** Carried; Short Corner; Bully; Sticks; Off side; Roll in; Striking Circle; Under-cutting; Dribble.
- ***Horse racing:*** Jockey; Punter.
- ***Polo:*** Bunker; Chukker; Mallet.
- ***Tennis:*** Back hand drive; Volley; Smash; Half-volley; Deuce; Service; Let; Grand Slam.

Stadiums and Places Associated with Sports

Name of Stadium	*Sports*	*Place*
Arun Jaitley Stadium	Cricket	Delhi
Jawaharlal Nehru Stadium	Athletics	Delhi
Shivajee Stadium	Hockey	Delhi
National Stadium	Hockey etc.	Delhi
Ambedkar Stadium	Football	Delhi
Brabourne Stadium	Cricket	Mumbai
Wankhede Stadium	Cricket	Mumbai
National Stadium	Hockey etc.	Mumbai
Eden Garden	Cricket	Kolkata
Green Park Stadium	Cricket	Kanpur
Keenan Stadium	Cricket	Jamshedpur
Nehru (Chepauk) Stadium	Cricket	Chennai
Barabati Stadium	Cricket	Cuttack
Lords, Oval, Leeds	Cricket	Britain
Hedingle Manchester	Cricket	Britain
Black Heath	Rugby Football	London
Henley	Boat race	England
Wimbledon	Lawn Tennis	London
Wembley Stadium	Football	London
White City	Dog-race	England
Aintree	Horse-race	England
Tentbridge	Cricket	England
Patnee Martlake	Boat-race	England
Tibankham	Rugby Football	England
Sandy Lodge	Golf	Scotland
Forest Hill	Tennis	New York
Brooklyn	Baseball	New York
Melbourne	Cricket	Australia

Name of Playing Compound of Different Games

Name of Compound	Related Sports
Court	Lawn Tennis, Badminton, Netball, Hand ball, Volleyball, Squash, Kho-Kho, Kabaddi
Diamond	Baseball
Ring	Boxing, Skating, Wrestling, Circus, Riding display
Course	Golf
Board	Table Tennis
Pool	Swimming
Alley	Bowling
Mat	Judo, Karate II
Arena	Horse Riding
Vellodrum	Cycling
Field	Polo, Football, Hockey
Track	Athletics
Pitch	Cricket, Rugby
Rink	Ice Hockey

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Multiple Choice Questions

1. Match List-I with List-II and select the correct answer from the codes given below the lists:

List-I

(*a*) Napoleon Bonaparte
(*b*) Jean Jacques Rousseau
(*c*) Croce
(*d*) Madame Roland

List-II

1. 'A history is contemporary history'
2. 'Liberty what crimes are committed in thy name'
3. 'Man is born free but everywhere he is in chains.'
4. 'I am the Child of Revolution'

Codes :

	(a)	*(b)*	*(c)*	*(d)*
A.	1	2	3	4
B.	4	3	1	2
C.	3	4	2	1
D.	3	4	1	2

2. Abraham Lincon was elected the President of United States in:
A. 1862 B. 1860
C. 1875 D. 1855

3. Who was known as the 'Prince of Humanists'?
A. Francisco Petrarch B. Dante
C. Boccacio D. Erasmus

4. D-Day is the day when:
A. Germany declared war on Britain
B. US dropped the atom bomb on Hiroshima.
C. Allied Troops landed in Normandy
D. Germany surrendered to the allies

5. Whose teachings inspired the French Revolution?
A. Locke
B. Rousseau
C. Hegel
D. Plato

6. At a time when empires in Europe were crumbling before the might of Napoleon which one of the following Governor-Generals kept the British flag flying high in India?
A. Warren Hastings B. Lord Cornwallis
C. Lord Wellesley D. Lord Hastings

7. Which one of the following statements regarding Fascism in Italy is *not* true?
A. The Fascists came to power as a result of popular uprising
B. In 1926, all political parties except Mussolini's party were banned
C. The Fascists suppressed the Socialist movement
D. The Fascists were hostile to the Communists

8. The fall of Czar Nicholas-II is known as:
A. Bloody Sunday
B. Bolshevik Revolution
C. February Revolution
D. October Revolution

9. Industrial Revolution took place first in:
A. France B. Germany
C. United Kingdom D. Japan

10. The British Prime Minister at the outbreak of World War II was :
A. Churchill B. Baldwin
C. Attlee D. Chemberlain

11. The 'Great Depression' (1929) economic crisis was met by adopting the policy of
A. Stimulus B. Marshall Plan
C. New Deal D. Open Door

12. The slogan "No taxation without representation" was raised during the:
A. American War of Independence
B. Russian Revolution
C. French Revolution
D. Indian Freedom struggle

13. In the nineteenth century the people of Europe started moving from the villages to the cities due to the impact of :
A. Epidemics
B. War
C. Industrialisation
D. Population explosion in villages

14. The important cause of the Civil War in America was:
A. Abolition of slavery
B. Quest for freedom
C. Industrialisation
D. Rebellion by the native Americans

15. Industrial Revolution could not have come about without:
A. Merchant capitalism
B. The Enclosure Movement
C. The services of the proletariat class
D. An agricultural revolution

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16. Consider the following statements :
The French Revolution came about mainly due to the :
1. Extreme poverty of the people
2. Impact of the works of great writers
3. Cruelty of the rulers
4. Impact of impulsive reaction
Which of the above statements are correct?
A. 1, 2 and 4 B. 2 and 3
C. 1, 3 and 4 D. 1, 2, 3 and 4

17. Asia's oldest and largest Buddhist monastery is situated in :
A. Tawang (Arunachal Pardesh)
B. Lhasa (Tibet)
C. Trincomallee (Sri Lanka)
D. Ulan Bator (Mongolia)

18. Who was the main architect of the Russian Revolution?
A. Karl Marx B. Lenin
C. Stalin D. Tolstoy

19. V.I. Lenin is associated with :
A. Russian Revolution of 1917
B. Chinese Revolution of 1949
C. German Revolution
D. French Revolution of 1789

20. Which one of the following statements is *not* correct?
A. Voltaire believed in Natural Religion
B. Rousseau wrote *Social Contract*
C. Montesquieu authored *The Spirit of Laws*
D. Necker believed in 'General Will'

21. 6th April, 1930 is well known in the history of India because this date is associated with.....
A. Dandi March by Mahatma Gandhi
B. Quit India Movement
C. Partition of Bengal
D. Partition of India

22. Which ruler enforced the system of 'Price Control' in India?
A. Mohammad Tughlak
B. Razia Begum
C. Alauddin Khilji
D. Sher Shah Suri

23. The concept of 'Din-e-Elahi' was founded by which king?
A. Dara Shikoh B. Akbar
C. Sher Shah Suri D. Shahjahan

24. Who are supposed to be the earliest inhabi-tants of India? Where did they come from?
A. Aryans from Central Asia
B. Dravidians from Mediterranean
C. Negroids from Africa
D. Bhils and the Santhals from West Asia

25. The one chief characteristic of temple architecture of the Gupta Age was :
A. Absence of dome
B. Huge size
C. Beautiful carvings
D. absence of a covered courtyard for the gathering of worshippers

26. The Rigveda consists of :
A. 1000 hymns B. 2028 hymns
C. 1028 hymns D. 1038 hymns

27. The central point in Ashoka's dharma was :
A. royalty to kings
B. peace and non-violence
C. respect to elders
D. religious tolerance

28. The social evil which was conspicuously absent during ancient India was :
A. *Sati*-System B. *Devadasi*-System
C. Polygamy D. *Purdah*-System

29. Which, among the following, can be accepted as a novelty introduced by Mughal emperors to their buildings?
A. Domes B. Minarets
C. Arches D. Attached gardens

30. The first ruler of India who defeated Muhammud of Ghur was :
A. Mularaja II of Gujarat
B. Prithviraja Chauhan of Delhi
C. Jayachand of Kannauj
D. Parmaldeva of Bundelkhand

31. What important event happened in India in 1911?
A. Bengal was partitioned
B. Non-Cooperation movement was launched
C. India's capital was shifted from Calcutta to Delhi
D. Mahatma Gandhi presided over the Congress session

32. The first phase of the Congress Party (1885-1905) was characterized by its efforts to secure:
A. limited independence
B. complete freedom
C. Indianization of services
D. constitutional reforms

33. The Muslim League demanded a separate homeland for the Indian Muslims openly for the first time at its annual session held in Lahore in the year :
A. 1931 A.D. B. 1936 A.D.
C. 1940 A.D. D. 1941 A.D.

34. Under whose governorship did the East India Company secure the Diwani Rights in Bengal, Bihar and Odisha from Emperor Shah Alam?
A. Lord Cornwallis
B. Lord William Bentinck
C. Lord Clive
D. Lord Wellesley

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35. The Simon Commission was generally boycotted by the Indian political parties. What was the reason for this general non-cooperation?
A. the Commission aimed at dividing the people
B. it was an 'all white' Commission
C. it came after the Jallianwala Bagh carnage
D. it was an eye wash

36. Aligarh Muslim University was founded by :
A. Dr. Saifuddin Kitchlu
B. Mohammad Ali Jinnah
C. Sir Syed Ahmed Khan
D. Maulana Mohammad Ali

37. Ibn Batutah was an African traveller visiting India during the time of :
A. Alivardi Khan
B. Ala-ud-din Khalji
C. Iltutmish
D. Mohammad-bin-Tughlaq

38. The battle of Wandiawash was fought in :
A. 1726 B. 1760
C. 1818 D. 1857

39. The abolition of *Sati* by government regulation was at the time of :
A. Warren Hastings B. Lord Wellesley
C. Lord Bentinck D. Lord Ahmerst

40. Pick out the wrong combination :
A. Dilwara Temple : Mt. Abu
B. Pashupati Temple : Kathmandu
C. Padmanabh Temple : Bangalore
D. Minakshi Temple : Madurai

41. Match the following:
(a) Chanhudaro *(b)* Kalibangan
(c) Lothal *(d)* Surkotada
1. Alleged discovery of the skeleton of horse.
2. Bead making.
3. Traces of a dock and ship on seal.
4. Evidence of ploughing the fields.
The Correct code is :

	(a)	(b)	(c)	(d)
A.	2	4	3	1
B.	2	1	3	4
C.	1	2	3	4
D.	2	1	4	3

42. Match the Harappan settlements with the banks of rivers on which they were located :

(a) Harappa	1. Ravi
(b) Mohenjodaro	2. Indus
(c) Ropar	3. Sutlej
(d) Kalibangan	4. Ghaggar
(e) Lothal	5. Bhogava

Codes :

	(a)	(b)	(c)	(d)	(e)
A.	1	2	3	4	5
B.	1	2	3	5	4
C.	2	1	3	5	4
D.	2	1	4	3	5

43. The Goddess 'Kannagi' whose many temples were erected during the 'Sangam Age' was the goddess of :
A. Chastity B. Love
C. Prowess D. Wisdom

44. The Jain goal of life is to attain deliverance from the fetters of mudane existence, the way to which lies through three jewels. Which one of the following was not included among the 'three jewels' of Jainism?
A. Right faith B. Right action
C. Right knowledge D. Right conduct

45. The most striking feature of the Ashokan pillar is polish. Name the Ashokan pillar which is considered to be the most graceful of all Ashokan pillars.
A. Sarnath
B. Rampurva
C. Laurya-Nandangarh
D. Rummindei

46. Which are the correct statements?
1. The land grants, started in Satavahana period, paved the way for feudal developments in India.
2. Silk and spices were the Chief Indian export articles of Indo-Roman trade.
3. The Guptas issued the largest number of gold coins in ancient India.
4. The first memorial of a 'SATI' dated 510 A.D. is found at Eran in Madhya Pradesh.
A. 1 and 2 B. 1, 3, and 4
C. 1 and 4 D. 1, 2, 3 and 4

47. Who among the following patronised the 'Gandhara' (Indo-Greek style) School of Art?
A. Ashoka, the Great
B. Harsha Vardhana
C. Kanishka
D. Chandragupta Vikramaditya

48. The Sultanate of Delhi had five ruling dynasties. The dynasty having longest and shortest period were :
A. Ilbari and Khalji
B. Tughlaq and Khalji
C. Tughlaq and Sayyid
D. Ilbari and Lodis

49. Which one of the following events took place at the last during reign of Muhammad-bin-Tughlaq?
A. Introduction of token currency
B. Increase of land-revenue in Doab
C. Transfer of Capital from Delhi to Devagiri.
D. Conquest of Khurasan and Iraq

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50. The most learned medieval Muslim ruler who was well versed in various branches of learning including astronomy, mathematics and medicine was :
A. Jalaluddin Khilji
B. Sikander Lodi
C. Ghiyasuddin Tughlaq
D. Muhammad-bin-Tughlaq

51. The 'Sufis' had 12 silsilas. They propounded the idea of Union with God through:
A. Love B. Rituals
C. Fasts D. Prayers

52. Match the following:
(*a*) Peshwa 1. Foreign affairs
(*b*) Panditrao 2. Audit and accounts
(*c*) Amatya 3. Providing grants to scholars
(*d*) Sumant 4. General supervision
5. Military affairs
Select the correct code :

	(*a*)	(*b*)	(*c*)	(*d*)
A.	2	3	4	5
B.	4	1	2	3
C.	4	3	2	1
D.	3	1	4	2

53. The Regulating Act of 1773 can be regarded as the first measure to :
A. assert the right of British Parliament to legislate for India
B. separate the legislature from the executive
C. separate the judiciary from the executive
D. centralise law-making

54. What was the exact constitutional status of the Indian Republic on 26th January, 1950?
A. A Democratic Republic
B. A Sovereign, Democratic Republic
C. A Sovereign, Secular, Democratic Republic
D. A Sovereign, Socialist, Secular, Democratic Republic

55. When the British obtained the grant of Diwani of Bengal, Bihar and Odisha they acquired the right to :
A. maintain law and order in these territories
B. administer civil justice and collect revenue in these territories
C. collect revenue and establish revenue administration in these territories
D. militarily defend these territories

56. Which of the following were responsible for the growth of nationalism in India during the British rule?
1. Economic exploitation of India.
2. Impact of western education.
3. Role of the Press.
Select the correct answer using the codes given below :
Codes:
A. 1, 2 and 3 B. 1 and 2
C. 2 and 3 D. 1 and 3

57. Which one of the following nationalist leaders has been described as being radical in politics but conservative on social issues?
A. G.K. Gokhale
B. B.G. Tilak
C. Lala Lajpat Rai
D. Madan Mohan Malviya

58. Provincial Autonomy in British India was envisaged by the :
A. Act of 1909 B. Act of 1919
C. Act of 1935 D. Act of 1947

59. Dyarchy means :
A. double government
B. a government in which the centre is very powerful
C. a government based on division of power between centre and provinces
D. None of the above

60. The Indian National Congress observed 'Independence Day' for the first time on 26th January in :
A. 1920 B. 1925
C. 1930 D. 1947

61. .....is situated near the banks of Sabarmati River
A. Bhavnagar B. Aurangabad
C. Ahmedabad D. Rajkot

62. Sericulture is:
A. science of the various kinds of serum
B. artificial rearing of fish
C. art of silkworm breeding
D. study of various cultures of a community

63. The most abundant constituents of earth's crust are:
A. Igneous rocks
B. Sedimentary rocks
C. Metamorphic rocks
D. Granite

64. Indian Standard Time is based on:
A. 80°E longitude B. 82½°E longitude
C. 110°E longitude D. 25°E longitude

65. Tides in the oceans are caused by :
A. Gravitational pull of the moon on the earth's surface including sea water
B. Gravitational pull of the sun on the earth's surface only and not on the sea water
C. Gravitational pull of the moon and the sun on the earth's surface including the sea water
D. None of these

66. Nagarjunasagar Project is situated on the river:
A. Tungabhadra B. Cauvery
C. Krishna D. Godavari

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67. The difference between the Indian Standard Time and the Greenwich Mean Time is:
A. – 3½ hours B. + 3½ hours
C. – 5½ hours D. + 5½ hours

68. Which of the following dams is not on Narmada river?
A. Indira-Sagar Project
B. Maheshwar Hydel Power Project
C. Jobat Project
D. Koyna Power Project

69. Which of the following statements is **not true** about the availability of water on the earth, the crisis for which is going to increase in the years to come?
A. About 97.5 per cent of the total volume of water available on the earth is salty
B. 80 per cent of the water available to us for use comes in bursts as monsoons
C. About 2.5 per cent of the total water available on the earth is polluted water and cannot be used for human activities
D. Possibility is that some big glaciers will melt in the coming ten-fifteen years and sea level will rise by 3-4 metres all over the earth

70. Which of the following is **not** a cash crop?
A. Jute B. Paddy
C. Cashewnut D. Sugarcane

71. Through which States does Cauvery River flow?
A. Gujarat, M.P., Tamil Nadu
B. Karnataka, Kerala, Tamil Nadu
C. Karnataka, Kerala, Andhra Pradesh
D. M.P., Maharashtra, Tamil Nadu

72. Indian Standard Time is the local time of 82½°E which passes through :
A. Guntur B. Delhi
C. Allahabad D. Kolkata

73. The 17th parallel defines the boundary between:
A. North and South Korea
B. USA and Canada
C. North and South Vietnam
D. China and Russia

74. During the period of south-west monsoon, Tamil Nadu remains dry because:
A. the winds do not reach this area
B. there are no mountains in this area
C. it lies in the rain shadow area
D. the temperature is too high to let the winds cool down

75. Which country does top in producing cocoa?
A. Ghana B. Brazil
C. Ivory Coast D. Nigeria

76. The biggest reserves of thorium are in :
A. India B. China
C. The Soviet Union D. U.S.A.

77. The Girnar Hills are situated in which of the following states?
A. Gujarat B. Karnataka
C. Madhya Pradesh D. Maharashtra

78. During December 22nd the sun is vertically over:
A. Tropic of Cancer B. Tropic of Capricorn
C. The Equator D. None of the above

79. Photosphere is described as the :
A. Lower layer of atmosphere
B. Visible surface of the sun from which radiation emanates
C. Wavelength of solar spectrum
D. None of the above

80. Broadly, there are three layers of the earth of the crust, the mantle and the core. The crust forms what percentage of the volume of the earth?
A. 0.5% B. 2.5%
C. 7.5% D. 12.5%

81. The grassland of Argentina is known as :
A. Pampas B. Campos
C. Savanna D. None of the above

82. Different seasons are formed because :
A. Sun is moving around the earth
B. of revolution of the earth around the Sun on its orbit
C. of rotation of the earth around its axis
D. All of the above

83. Eskers and Drumlins are features formed by:
A. underground water
B. running water
C. the action of wind
D. glacial action

84. Match List-I and List-II and select the correct answer using the codes given below the Lists :

List-I *(Rivers)*	**List-II** *(Towns)*
(*a*) Ghaghara	1. Lucknow
(*b*) Brahmaputra	2. Hoshangabad
(*c*) Narmada	3. Ahmedabad
(*d*) Sabarmati	4. Guwahati
	5. Ayodhya

	(*a*)	(*b*)	(*c*)	(*d*)
A.	4	5	1	2
B.	5	4	2	3
C.	5	4	3	1
D.	3	5	2	1

85. Which of the statements as regards the consequences of the movement of the earth is not correct?
A. Revolution of the earth is the cause of the change of seasons.
B. Rotation of the earth is the cause of days and nights.

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C. Rotation of the earth causes variation in the duration of days and nights.
D. Rotation of the earth effects the movement of winds and ocean currents.

86. The world is divided into :
A. 12 time zones B. 20 time zones
C. 24 time zones D. 36 time zones

87. The 'Kiel' canal links the :
A. Pacific and Atlantic Oceans
B. Mediterranean Sea and Red Sea
C. Mediterranean Sea and Black Sea
D. North Sea and Baltic Sea

88. Match the following :

List-I	**List-II**
(*a*) Himadri	1. Outer Himalayas
(*b*) Shivalik	2. Inner Himalayas
(*c*) Himanchal	3. Middle Himalayas
(*d*) Sahyadri	4. Western Ghats

Codes:

	(*a*)	(*b*)	(*c*)	(*d*)
A.	1	2	3	4
B.	4	2	3	1
C.	2	1	3	4
D.	1	2	3	4

89. The term 'Regur' refers to:
A. Laterite soils
B. Black Cotton soils
C. Red Soils
D. Deltaic Alluvial Soils

90. Location of sugar industry in India is shifting from north to south because of:
A. cheap labour
B. expanding regional market
C. cheap and abundant supply of power
D. high yield and high sugar content in sugarcane

91. Consider the following statements :
1. Ozone is found mostly in the Stratosphere.
2. Ozone layer lies 55-75 km above the surface of the earth.
3. Ozone absorbs ultraviolet radiation from the Sun.
4. Ozone layer has no significance for life on the earth.

Which of the above statements are correct?
A. 1 and 3 B. 2 and 4
C. 2 and 3 D. 1 and 4

92. Match List-I with List-II and select the correct answer using the codes given below the Lists :

List-I *(Crops)*	**List-II** *(Producer)*
(*a*) Banana	1. Brazil
(*b*) Cocoa	2. Cote d'Ivoire
(*c*) Coffee	3. India
(*d*) Tea	4. China

Codes :

	(a)	*(b)*	*(c)*	*(d)*
A.	2	3	1	4
B.	3	2	1	4
C.	3	2	4	1
D.	2	3	4	1

93. Darjeeling and Dharamsala would be the right places to visit if one wanted to get a clear view respectively of :
A. Kanchanjunga and Dhauladhar ranges
B. Nandadevi and Dhauladhar ranges
C. Kanchanjunga and Nandadevi ranges
D. Nandadevi and Nanga Parvat

94. Atmosphere exists because:
A. The Gravitational force of the Earth
B. Revolution of the Earth
C. Rotation of the Earth
D. Weight of the gases of atmosphere

95. Victoria lake is located in the continent:
A. Africa
B. Asia
C. North America
D. South America

96. The famous Lagoon Lake of India is :
A. Dal Lake B. Chilka Lake
C. Pulicat Lake D. Mansarover

97. Where are most of the earth's active volcanoes concentrated?
A. Indian Ocean B. Pacific Ocean
C. Aral Sea D. Atlantic Ocean

98. Through which of the following states does the river Chambal flow?
A. U.P., M.P., Rajasthan
B. M.P., Gujarat, U.P.
C. Rajasthan, M.P., Bihar
D. Gujarat, M.P., U.P.

99. Which country is called the sugar bowl of the world?
A. Cuba B. India
C. Argentina D. USA

100. The area covered by forest in India is about:
A. 46% B. 33%
C. 21.71% D. 28%

101. A closed economy is the one which :
A. does not permit emigration or immigration
B. permits emigration but no immigration
C. engages in no foreign trade
D. engages in no foreign and domestic trade or transit

102. In a developed economy the major share of employment originates in the :
A. primary sector B. tertiary sector
C. secondary sector D. any of the above

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103. The Economic and Social Commission for Asia and Pacific (ESCAP) is located at :
A. Bangkok B. Kuala Lumpur
C. Manila D. Singapore

104. Commercial vehicles are not produced by which of the following companies in India?
A. TELCO B. Ashok Leyland
C. DCM Daewoo D. Birla Yamaha

105. In India, the Public Sector is most dominant in:
A. transport
B. steel production
C. commercial banking
D. organised term-lending financial institutions

106. The main argument advanced in favour of small scale and cottage industries in India is that:
A. cost of production is low
B. they require small capital investment
C. they advance the goal of equitable distribution of wealth
D. they generate a large volume of employment

107. The most serious economic problems of India are:
A. Poverty and unemployment
B. Stagnation, not poverty
C. Unemployment, not poverty
D. Underdevelopment, not poverty

108. Which of the following is not one of the three central problems of an economy?
A. What to produce
B. How to produce
C. When to produce
D. For whom to produce

109. Gender Responsive Budgeting has been adopted in India in the year:
A. 2017 B. 2004
C. 2014 D. 2005

110. In which of the following industries in India are the maximum number of workers employed?
A. Sugar B. Jute
C. Textiles D. Iron and Steel

111. Terrace Cultivation is practiced mostly:
A. in urban areas
B. on slopes of mountains
C. on tops of hills
D. in undulating tracts

112. Which of the following is a Selective Credit Control method?
A. Bank Rate
B. RBI directives
C. Cash Reserve Ratio
D. Open market operations

113. Which of the following taxes is not shared by the Central Government with the States?
A. Union excise duties
B. Customs duty
C. Income tax
D. Estate duty

114. ICICI is the name of a:
A. Financial Institution
B. Chemical Industry
C. Cotton Industry
D. Chamber of Commerce and Industry

115. Structural Unemployment arises due to
A. Deflationary conditions
B. Heavy industry bias
C. Shortage of raw material
D. Inadequate productive capacity

116. Which of the following is the largest single source of the government's earning from tax revenue?
A. Excise duties
B. Customs duties
C. Corporation tax
D. Income tax

117. The largest public sector bank in India is:
A. Central Bank of India
B. Punjab National Bank
C. State Bank of India
D. Indian Overseas Bank

118. Which of the following statements best explains the term contraband goods?
A. Goods produced only for exports
B. Goods produced in joint sector only
C. Goods for the trading of which licence is not required
D. Goods that are forbidden, from export, import or even possession, by law

119. Price in the market is fixed by:
A. Stock exchange rates
B. The demand and supply ruling in the market at a particular time
C. The Finance Minister
D. None of the above

120. Devaluation of currency helps to promote:
A. National Income
B. Savings
C. Imports at lower cost
D. Exports

121. Balanced economic growth can be achieved only if:
A. All the sectors of economy grow at the same rate
B. Population growth is arrested
C. All the inter dependent sectors grow in harmony
D. Basic and heavy industries are assigned highest priority

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122. 'Blue Revolution' is related to:
A. Fishries B. Poultry
C. Space Research D. Drinking Water

123. What is "hotline"?
A. A telecommunication link
B. An electric wire
C. Hard disk
D. Modem

124. Which of the following banks has launched 'No Q' App?
A. ICICI Bank B. SBI Bank
C. AXIS Bank D. None of the above

125. The term 'devaluation' means:
A. Reducing the value of a currency in terms of another currency
B. Increasing the value of a currency
C. Revising the value of a currency
D. None of the above

126. Per capita net availability of pulses has shown a tendency of:
A. Increase over time
B. Decrease over time
C. Constant over time
D. First increase then decrease

127. National Income is the same as:
A. Net national product at market price
B. Net domestic product at market price
C. Net national product at factor cost
D. Net domestic product at factor cost

128. Which one of the following is not an example of indirect tax?
A. Sales tax B. Excise duty
C. Customs duty D. Expenditure tax

129. The major aim of devaluation is to:
A. encourage imports
B. encourage exports
C. encourage both exports and imports
D. discourage both exports and imports

130. Structural unemployment arises due to:
A. deflationary conditions
B. heavy industry bias
C. shortage of raw materials
D. inadequate productive capacity

131. When was the Family Planning Programme officially started in India?
A. 1950 B. 1952
C. 1956 D. 1962

132. When was the Reserve Bank of India nationalised?
A. 1947 B. 1949
C. 1950 D. 1951

133. Which of the following is *not* a feature of the Indian economy?
A. High rate of population growth
B. Disguised unemployment
C. Lowest rate of adult literacy
D. High rate of exports

134. The 'Relative Deprivation' approach for measuring poverty has been adopted by:
A. developing countries
B. developed countries
C. under-developed countries
D. None of the above

135. One of the main factors that led to rapid expansion of Indian exports is:
A. Imposition of import duties
B. Liberalisation of the economy
C. Recession in other countries
D. Diversification of exports

136. Sustainable economic development means an increase in the rate of growth of real:
A. total and per capita product
B. total and per capita product and level of literacy rate
C. total and per capita product and life expectancy at birth
D. total and per capita product, taking into account the cost of degradation of the quality of environment in this process

137. Functional unemployment occurs when:
A. unemployed have no qualification for job
B. people frequently change their job
C. people were thrown out from job due to recession
D. None of these

138. Which among the following does **not** have a 'free trade zone'?
A. Kandla B. Mumbai
C. Visakhapatnam D. Thiruvanantpuram

139. Sun Belt of USA is important for which one of the following industries?
A. Cotton textile
B. Petrochemicals
C. Hi-tech electronics
D. Food Processing

140. Commercial banking system in India is
A. unit banking B. branch banking
C. mixed banking D. None of the above

141. Who gives recognition to political parties in India?
A. Parliament B. President
C. Supreme Court D. Election Commission

142. The Quorum of the Legislative Council is :
A. one-fourth of its total membership

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B. one-third of its membership
C. one-tenth of its membership
D. 25

143. The Indian Constitution is:
A. federal
B. unitary
C. a happy mixture of the federal and unitary
D. federal in normal times and unitary in times of emergency

144. Universal adult franchise implies a right to vote to all:
A. adult residents of the State
B. adult male citizens of the State
C. residents of the State
D. adult citizens of the State

145. When a resolution prefering a charge against the President has been passed by a specified majority in the House, it is sent to the other House for investigation. If, as a result of such an investigation, a resolution is passed through a specified majority by the other House, declaring that the charge has been sustained, the President shall leave his office. The specified special majority must not be less than :
A. two-third of the members present and voting
B. one-third of the members present and voting
C. three-fourth of the members present and voting and two-third of the total membership
D. two-third of the total membership

146. Which one of the following judicial powers of the President of India has been *wrongly* listed?
A. he appoints the Chief Justice and other judges of the Supreme Court
B. he can remove the judges of the Supreme Court on grounds of misconduct
C. he can consult the Supreme Court on any question of law or fact which is of public importance
D. he can grant pardon, reprieves and respites to persons punished under Union Law

147. The Vice-president of India can be removed from his office before the expiry of his term if :
A. the Rajya Sabha passes a resolution by a majority of its members and the Lok Sabha agrees with the resolution
B. if the Supreme Court of India recommends his removal
C. the President so desires
D. None of the above

148. The Chief Justice of a High Court in India is appointed by the :
A. Governor of the State
B. Prime Minister of India
C. Chief Justice of the Supreme Court
D. President of India

149. Which of the following statements is constitu-tionally not true about the passing of the Union Budgets and Finance Bill in India?
1. Under the law, Finance Bill should be adopted by both the Houses of the Parliament within 45 days of its introduction.
2. If the Finance Bill is not adopted within specified period, the government loses its authority to levy the taxes proposed in the budgets.
3. In the absence of full budget, a vote-on-account gives the power to the government to spend.
4. Government cannot raise revenues without a proper approval of the Finance Bill

A. Only 2 B. Only 3
C. Only 4 D. Only 1, 2 and 3

150. Normally, on whose advice the President's Rule is imposed in a State?
A. Chief Minister
B. Legislative Assembly
C. Governor
D. Chief Justice of High Court

151. Which Article of the Indian Constitution deals with Amendment procedure?
A. Article 368 B. Article 358
C. Article 367 D. All of these

152. Government is the agency through which the will of :
A. the state is expressed
B. the people is expressed
C. the head of the state is expressed
D. the majority is expressed

153. In a unitary system of government :
A. The centre is all powerful
B. The centre is weaker than the states
C. The centre and states stand at par
D. The states and centre are supreme in their respective spheres

154. In Cabinet System of Government the real executive authority rests with :
A. The Council of Ministers
B. The Prime Minister
C. The Constitution
D. The Parliament

155. The Head of the State under a parliamentary government:
A. is an elected representative
B. is a hereditary person
C. is a nominated person
D. may be any one of the above

156. In the event of a ministerial proposal being defeated on the floor of the legislature, under the parliamentary system :
A. the government waits for a general no-confidence motion

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B. the minister concerned is taken to task by the Prime Minister
C. the minister is forced to resign
D. the whole Council of Ministers resign

157. The "due process of law" is an essential characteristic of the judicial system of:
A. UK B. France
C. USA D. India

158. Under the Constitution it is :
A. obligatory for the President to accept the advice of the Council of Ministers but is not obliged to follow it
B. obligatory for the President to accept the advice of the Council of Ministers
C. not obligatory for the President to seek or accept the advice of the Council of Ministers
D. obligatory for the President to seek the advice of the Council of Ministers if his own party is in power

159. Which one of the following statements is correct?
A. the Presiding Officer of Rajya Sabha is elected every year
B. the Presiding Officer of Rajya Sabha is elected for a term of two years at a time
C. the Presiding Officer of Rajya Sabha is elected for a term of six years
D. the Vice-President of India is the ex-officio Presiding Officer of Rajya Sabha

160. The introduction of "no confidence" motion in the Lok Sabha requires the support of at least:
A. 50 members B. 70 members
C. 60 members D. 80 members

161. The High Court comes under :
A. State List B. Union List
C. Concurrent List D. None of the above

162. Which one of the following has been wrongly listed as a Fundamental Duty of the Indian citizens?
A. to develop scientific temper, humanism and spirit of inquiry and reform
B. to work for raising the prestige of the country in the international sphere
C. to protect and improve the natural environment
D. to strive towards excellence in all spheres of individual and collective activity

163. Which one of the following is not a Fundamental Duty as outlined in Article 51A of the Constitution?
A. to abide by the Constitution and respect its ideals
B. to defend the country and render national service when called upon to do so
C. to work for the moral upliftment of the weaker sections of society
D. to preserve the rich heritage

164. The main characteristics of the Directive Principles of State Policy given in the Indian Constitution are :
A. not enforceable by any court
B. fundamental in the governance of the country
C. 'Like instruments, instructions, political manifesto and a code of moral precepts which have to guide governors of the country'
D. no law can be passed, which is opposed to these principles

165. Of the following which are true?
A. In a State, the Legislative Council is dominant with regard to non-financial bills and the Legislative Assembly with regard to financial (money) bills
B. Vidhan Parishad can virtually block legisla-tion even if the same is passed by the Vidhan Sabha
C. In case of a tie between the two Houses, the Governor is duty-bound to call a joint session of the two Houses to have the issue settled on a majority verdict
D. If a Bill is twice approved by the Vidhan Sabha, it becomes law even if rejected by the Vidhan Parishad

166. Which one of the following types of emergency can be declared by the President?
A. Emergency due to threat of war and external aggresion
B. Emergency due to break-down of constitu-tional machinery in a State
C. Financial emergency on account of threat to the financial credit of India
D. all the three emergencies

167. The chairman of which of the following parliamentary committees is invariably from the members of ruling party?
A. Committee on public undertakings
B. Public accounts committee
C. Estimates committee
D. Committee on delegated legislation

168. Which of the following is not a formally prescribed device available to the members of parliament?
A. Question hour
B. Zero hour
C. Half-an-hour discussion
D. Short duration discussion

169. Which of the following is not a tool of executive control over public administration?
A. Power of appointment and removal
B. Line agencies
C. Appeal to public opinion
D. Civil services code

170. If the Speaker of the State Legislative Assembly decides to resign, he should submit his resignation to the:
A. Judges of the High Court
B. Deputy Speaker
C. Chief Minister
D. Finance Minister

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171. Which tax can be levied by Gram Panchayat?
A. Sales Tax
B. Custom Duty
C. Land Revenue
D. Tax on Local Fairs

172. India is a Federal State because of:
A. dual judiciary
B. dual citizenship prevalent here
C. share of power between the Centre and the States
D. rigid Constitution

173. Residuary Subjects are those subjects which are:
A. contained in the State list
B. contained in the Union list
C. contained in the Concurrent list
D. not covered by any of the three lists

174. Which of the following writs can be issued, by the Supreme Court, to enforce Fundamental Rights?
A. Writ of Habeas Corpus
B. Writ of Mandamus
C. Writ of Quo Warranto
D. All of these

175. When the offices of both the President and the Vice-President of India are vacant, who will discharge their functions?
A. Prime Minister
B. Home Minister
C. Chief Justice of India
D. The Speaker

176. The Supreme Court tenders advice to the President of India on a matter of law or fact:
A. on its own
B. only when such advice is sought
C. only if the matter relates to some basic issue
D. only if the issue poses a threat to the unity and integrity of the country

177. Six months shall **not** intervene between two sessions of the Indian Parliament because :
A. it is the customary practice
B. it is the British convention followed in India
C. it is an obligation under the Constitution of India
D. None of the above

178. The States of the Indian Union can be recognised or their boundaries altered by:
A. the Union Parliament by a simple majority in the ordinary process of legislation
B. two-thirds majority of both the Houses of Parliament
C. two-thirds majority of both the Houses of Parliament and the consent of the legisla-tures of concerned States
D. an executive order of the Union government with the consent of the concerned State governments

179. The Basic Feature theory of the Constitution of India was propounded by the Supreme Court in the case of :
A. Minerva Mills Vs. Union of India
B. Golaknath Vs. State of Punjab
C. Maneka Gandhi Vs. Union of India
D. Keshavananda Vs. State of Kerala

180. Which one of the following writs is issued by a court in case of illegal detention of a person?
A. Habeas corpus B. Mandamus
C. Certiorari D. Quo-warranto

181. Name the instrument with the help of which a sailor in a submarine can see the objects on the surface of the sea.
A. Telescope B. Periscope
C. Gycroscope D. Stereoscope

182. 'HEMOPHILLIA' is the disease of .....
A. liver B. blood
C. brain D. bones

183. Vitamin A is abundantly found in .....
A. Brinjal B. Tomato
C. Carrot D. Cabbage

184. ..... is not soluble in water.
A. Vitamin A B. Vitamin B
C. Vitamin C D. None of these

185. The blood vessels with the smallest diameter are called .....
A. capillaries B. arterioles
C. venules D. lymphatics

186. Out of the following ..... has the greatest elasticity.
A. steel B. rubber
C. aluminium D. annealed copper

187. Cooking gas is a mixture of which of the following two gases?
A. Carbon Dioxide and Oxygen
B. Butane and Propane
C. Carbon Monoxide and Carbon Dioxide
D. Methane and Ethylene

188. The substance most commonly used as a food preservative is:
A. sodium carbonate B. tartaric acid
C. acetic acid D. benzoic acid

189. Normally, the substances that fight against diseases in human systems are known as:
A. dioxyribonucleic acids
B. carbohydrates
C. enzymes
D. antibodies

190. The SI unit of temperature is .....
A. Kelvin B. Celsius
C. Fahrenheit D. None of the above

191. One of the common fungal diseases of man is :
A. plague B. ringworm
C. cholera D. typhoid

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192. A clear sky is blue because:
A. red light is scattered more than blue
B. ultraviolet light has been absorbed
C. blue light is scattered more than red
D. blue light has been absorbed

193. Jenner introduced the method of making people immune to :
A. small pox B. rabies
C. cholera D. polio

194. The largest cell in the human body is :
A. Nerve cell B. Live cell
C. Muscle cell D. Kidney cell

195. What is the device that steps up or steps down the voltage?
A. Dynamo B. Conductor
C. Inductor D. Transformer

196. The protein deficiency disease is known as :
A. Kwashiorker B. Cirrhosis
C. Eczema D. Clycoses

197. Iron deficiency causes :
A. rickets B. anaemia
C. cirrhosis D. goitre

198. Blood group of an individual is controlled by :
A. Haemoglobin B. Shape of RBC
C. Shape of WBC D. Genes

199. In a normal man the amount of blood pumped out by the heart per minute is about :
A. 1 litre B. 3 litres
C. 4 litres D. 5 litres

200. Red/green colour blindness in man is known as :
A. Protanopia
B. Deutetanopia
C. Both A and B above
D. Marfan's syndrome

201. The blue colour of the water in the sea is due to :
A. Reflection of the blue light by the impurities in sea water
B. Reflection of the blue sky by sea water and scattering of blue light by water molecules
C. Absorption of other colours by water molecules
D. None of the above

202. The image formed on the retina of the eye is:
A. upright and real
B. larger than the object
C. small and inverted
D. enlarged and real

203. Unit of loudness of sound is:
A. bel B. decibel
C. phon D. none of these

204. Oil rises up the wick in a lamp :
A. because oil is volatile
B. due to the capillary action phenomenon
C. due to the surface tension phenomenon
D. because oil is very light

205. The 'stones' formed in human kidney consist mostly of :
A. calcium oxalate
B. sodium acetate
C. magnesium sulphate
D. calcium

206. We hear the sound later, while the light is seen earlier:
A. because light's speed is more than that of sound
B. because lights travel in a straight direction while sound in a zigzag direction
C. because sound's frequency is lower than light
D. All of the above

207. Which part of an eye is transplanted?
A. Cornea B. Retina
C. Iris D. Sciera

208. The Universal donor group of blood is:
A. O B. A
C. B D. AB

209. The green colour of the leaf is due to :
A. Presence of Chloroplast
B. Presence of Chromium
C. Presence of Nicoplast
D. Presence of excess of oxygen

210. Voice of a child is more shrill than that of an elderly person because:
A. the pitch of the child's voice is higher than that of the person
B. the pitch is lower
C. the child is more energetic
D. None of the above

211. Camel uses its hump for :
A. storing water
B. storing fat
C. for balancing the body
D. temperature regulation

212. A man standing in a free falling lift releases a ball from his hand. The ball would be :
A. moving down
B. moving up
C. stationary
D. moving up and down

213. To change the quality of sound produced by an instrument we need to vary the:
A. pitch B. loudness
C. amplitude D. number of overtonnes

214. The disease caused by Asbestos is:
A. Emphysema B. Paralysis
C. Diarrhoea D. Dysentery

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215. Sweetness of a sound depends upon its
A. wavelength
B. frequency
C. amplitude
D. periodicity and regularity

216. Bats can fly in the dark because :
A. they have a better vision in the dark
B. the pupils of their eyes are very big
C. they are guided by ultrasonic waves produced by them
D. any bird can do so

217. Blood is formed in the human adult by the :
A. heart B. spleen
C. kidney D. bone marrow

218. Pencil 'lead' is made up of:
A. graphite B. charcoal
C. lead oxide D. lampblack

219. The deficiency of which one of the following vitamins leads to bleeding of gums and loosening of teeth?
A. Vitamin D B. Vitamin C
C. Vitamin B D. Vitamin A

220. How much blood does a normal person have in his body?
A. 8 litres B. 4 to 5 litres
C. 10 litres D. 2 litres

221. Match List-I with List-II and select the correct answer using the codes given below the Lists :

List-I	**List-II**
(*a*) Visakhadatta	1. Mrichhakatika
(*b*) Shudraka	2. Ritusamhara
(*c*) Kalidasa	3. Kamasutra
(*d*) Vatsyayana	4. Devichandraguptam

Codes :

	(*a*)	(*b*)	(*c*)	(*d*)
A.	1	4	2	3
B.	4	1	3	2
C.	1	4	3	2
D.	4	1	2	3

222. In which one of the following langauges is the *Dalit* writing more conspicuous?
A. Punjabi B. Assamese
C. Marathi D. Odiya

223. The first writer to use Urdu as the medium of poetic expression was:
A. Amir Khusrau
B. Mirza Ghalib
C. Bahadur Shah Zafar
D. Faiz

224. The religious text of the Zoroastrians is named as:
A. Torah B. The Analects
C. Tripatika D. Zend Avesta

225. Name the music duo which composed music for Raj Kapoor's film 'Bobby'?
A. Laxmikant Pyarelal B. Shankar Jaikishen
C. Kalyanji Anandji D. Nadeem Shravan

226. Raja Harishchandra, an early Indian film, was produced by :
A. D.G. Phalke B. Ashok Kumar
C. Ardeshir Irani D. None of the above

227. All films are certificed by ..... before they are publicly exhibited.
A. Films Division
B. National Film Development Corporation (NFDC)
C. Directorate of Advertising and Visual Publicity (DAVP)
D. Central Board of Film Certificate (CBFC)

228. Who among the following was the director of the film 'Taal'?
A. Gulzar B. Shekhar Kapoor
C. Satish Shah D. Subhash Ghai

229. Who amongst the following actresses has played the leading role in the film Elizabeth?
A. Gwyneth Paltrow B. Cate Blanchett
C. Simi Garewal D. Kim Basinger

230. The film 'Train to Pakistan' is based on the novel of the same name, written by:
A. Bhishma Sahani
B. Khushwant Singh
C. Amrita Pritam
D. Khwaja Ahmed Abbas

231. Which of the following is a folk dance form of Jharkhand?
A. Pali B. Jhumar
C. Nati D. Chhau

232. The first feature film (talkie) to be produced in India was:
A. Hatimtai B. Alam Ara
C. Pundalik D. Raja Harishchandra

233. Who directed the film "Bombay"?
A. Shyam Benegal B. Meera Nair
C. Shekhar Kapoor D. Mani Ratnam

234. Late Iftekhar Ahmad was famous in which of the following fields?
A. Acting B. Singing
C. Music D. Literature

235. Who among the following is the director of the film 'The Kashmir Files'?
A. Subhash Ghai B. Shekhar Kapoor
C. Ramesh Sippy D. Vivek Agnihotri

236. The character played by Jim Carrey in the movie *Man on Moon* is based on:
A. Andy Kaufman B. Edwin Aldrin
C. John Glenn D. Neil Armstrong

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237. A popular Hindi film-based on the famous Sanskrit play *Mrichhakatika*, was titled:
A. Meghadoot B. Amrapali
C. Utsav D. Shakuntala

238. Who composed the song 'Zara Yad Karo Kurbani'?
A. Javed Akhtar
B. Pradeep
C. Nusrat Fateh Ali Khan
D. Raghupati Sahay 'Firaq'

239. Who was the producer of the serial 'Mahabharat'?
A. Shyam Benegal B. B.R. Chopra
C. Ramanand Sagar D. Mani Ratnam

240. Which of the following is a folk dance of Rajasthan?
A. Garba B. Dandya
C. Jhumar D. Kathak

241. 'The Colonel' is the nickname of which Indian Test Cricketer?
A. Colonel C.K. Naidu
B. Rahul Dravid
C. Mohinder Amarnath
D. Dilip Vengsarkar

242. The term 'Grandmaster' is used in which of these games?
A. Judo B. Chess
C. Bridge D. Karate

243. The term "Derby" is related with which of the following?
A. Polo B. Swimming
C. Racing D. Horse Racing

244. With which game is Geet Sethi associated?
A. Basketball B. Chess
C. Snooker D. Tennis

245. Beighton Cup is related with which of the following?
A. Hockey B. Polo
C. Cricket D. Soccer

246. Match List-I with List-II and select the correct answer using the codes given below the Lists :

List-I	List-II
(a) Basketball	1. Lob
(b) Bridge	2. Revoke
(c) Golf	3. Pivot
(d) Tennis	4. Bunker

Codes :

	(a)	*(b)*	*(c)*	*(d)*
A.	2	3	1	4
B.	2	3	4	1
C.	3	2	1	4
D.	3	2	4	1

247. The head office of the International Cricket Council (ICC) is situated in :
A. Zimbabwe B. Australia
C. South Africa D. UAE

248. Match the following :

List-I	List-II
(a) Deodhar Trophy	1. Volleyball
(b) Durand Cup	2. Football
(c) Davis Cup	3. Cricket
	4. Tennis

Codes:

	(a)	*(b)*	*(c)*
A.	3	2	4
B.	3	1	4
C.	2	3	1
D.	1	2	4

249. Which of the following is called 'Grand Slam'?
A. Winning the highest number of medals in the Olympic games
B. Winning the men's singles title in Wimbledon Championship
C. Winning the Wimbledon Singles title successively for two years
D. Winning all the four championships Australian, French, Wimblendon and US

250. With which game is the term 'butterfly stroke' associated?
A. Swimming B. Cricket
C. Gliding D. Skiing

251. Who is the first Indian to win the 'International Grand Master' title in Chess?
A. Anupama Abhayankar
B. Bhagyashree Sathe Thipsay
C. Vishwanathan Anand
D. D.V. Prasad

252. The XXI Commonwealth Games were held in 2018 in :
A. Kuala Lumpur B. Bangkok
C. Victoria D. Queensland

253. The term 'Tee' is associated with which of the following sports?
A. Golf B. Table Tennis
C. Polo D. Judo

254. The famous woman Tennis player who was stabbed during a match, is
A. Steffi Graf B. Monica Seles
C. Mary Pierce D. Martina Navratilova

255. The term 'Baseline' is related to which of the following?
A. Golf B. Hockey
C. Badminton D. Polo

256. In which Indian State did the game of Polo originate?
A. Manipur B. Rajasthan
C. Gujarat D. West Bengal

257. Viswanathan Anand is associated with which sport?
A. Tennis B. Badminton
C. Chess D. Mountaineering

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258. Rafael Nadal is the well-known player associated with:
A. Hockey B. Cricket
C. Tennis D. Chess

259. Neeraj Chopra is the well-known player associated with :
A. Javelin Throw B. Golf
C. Table Tennis D. Chess

260. Eden Garden, a famous Cricket stadium, is located in :
A. Kanpur B. Kolkata
C. Jamshedpur D. Pune

261. Maharaja Ranjit Singh Trophy is associated with :
A. Golf B. Hockey
C. Soccer D. Tennis

262. Jaspal Rana is a distinguished athlete in which of the following games?
A. Swimming B. Weightlifting
C. Shooting D. Archery

263. Cricket was an Olympic event at which of the following Olympics?
A. London, 1908 B. Amsterdam, 1928
C. Paris, 1900 D. Melbourne, 1956

264. WISPA competitions are associated with :
A. Squash B. Yatching
C. Boxing D. Billiards

265. Ryder Cup is the famous trophy of :
A. Golf B. Chess
C. Boxing D. Polo

266. Davis Cup is associated with the sport of :
A. Cricket B. Football
C. Tennis D. Hockey

267. 'Volley', 'Chop' and 'Drive Spine' are the term associated with :
A. Lawn Tennis B. Badminton
C. Table Tennis D. Golf

268. Lal Bahadur Shastri Stadium is located at :
A. Hyderabad B. Chennai
C. Ahmedabad D. Varanasi

269. The first winner of "Rajiv Gandhi Khel Ratna Award" (Now Major Dhyanchand Khel Ratna Award) was :
A. Geet Sethi
B. Sachin Tendulkar
C. Viswanathan Anand
D. Karnam Malleswari

270. The winner of 2019 Cricket World Cup is:
A. England B. Sri Lanka
C. Bangladesh D. Australiya

271. The first team event introduced in 1900 at Paris Olympics was :
A. Hockey B. Football
C. Cricket D. Baseball

272. Which of the following international tennis tournaments is held on grass court?
A. US Open B. French Open
C. Wimbledon D. Australian Open

273. Which cricketer is nicknamed as the pied piper of Punjab?
A. Yuvraj Singh
B. Harbhajan Singh
C. Mohinder Amarnath
D. Navjot Singh Sidhu

274. 'Merdeka Cup' is associated with .....
A. Golf B. Football
C. Squash D. Hockey

275. The first time athletes marched into the stadium behind their nation's flag in Olympics:
A. at St. Louis 1904 B. at London 1908
C. at Antwerp 1920 D. at Paris 1924

276. The "Dronacharya Award" is associated with:
A. Eminent Surgeons B. Famous Sports Person
C. Sport Coaches D. Expert Engineers

277. Which cricketer is nicknamed as 'Jumbo'?
A. Venkatesh Prasad B. Anil Kumble
C. Glenn McGrath D. Shane Warne

278. The first time the Olympic Games were organised by a private company at:
A. Montreal, 1976 B. Los Angeles, 1984
C. Atlanta, 1996 D. Rome, 1960

279. In which Asian Games Cricket was played first?
A. Guangzhou, 2010 B. Doha, 2006
C. Busan, 2002 D. Seoul, 1986

280. The term 'Penalty cick' is used in :
A. Hockey B. Football
C. Baseball D. Golf

281. Which of the following countries is not a member of North Atlantic Treaty Organisation (NATO)?
A. Norway B. United Germany
C. Portugal D. Australia

282. Khmer Rouge is a dictatorial party of :
A. Cambodia B. Indonesia
C. Malaysia D. Thailand

283. Which country is not a member of SAARC?
A. Russia B. Bangladesh
C. Nepal D. Pakistan

284. The headquarters of WTO is located at :
A. Geneva B. Paris
C. The Hague D. Washington

285. The main function of the World Trade Organisation (WTO) is:
A. enforcing of Uruguay Round Agreements

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B. facilitating multi-lateral trade relations of member countries and reviewing trade policies
C. administering trade dispute settlement procedures
D. None of the above

286. The Secretary-General of the UNO is appointed by the:
A. General Assembly
B. Security Council
C. Trusteeship Council
D. World Bank

287. The United Nations officially came into existence in 1945 on :
A. November 24 B. October 14
C. October 24 D. November 14

288. Which one of the following is true of the International Court of Justice?
A. The Judges of the Court are appointed according to the discretion of the Secretary General
B. No two Judges may belong to the same country
C. The Court consists of 20 Judges
D. The statute of the International Court of Justice is not an integral part of the UN Charter

289. Which of the following was not among the six founding countries of the European Community?
A. Belgium B. France
C. Germany D. UK

290. The smallest country in South America is:
A. Ecuador B. Guyana
C. Surinam D. Uruguay

291. In which year "Human Rights Resolution" was adopted by the U.N.?
A. 1945 B. 1946
C. 1947 D. 1948

292. Where is the headquarters of INTERPOL located?
A. Berlin B. California
C. Lyons D. Montreal

293. Parliament of which of the following countries is known as Great People's Khural?
A. Malaysia B. Mongolia
C. Thailand D. Indonesia

294. Numbers of major organs of United Nations are:
A. 3 B. 4
C. 5 D. 6

295. When is the UN Day celebrated?
A. October 24 B. January 24
C. June 24 D. September 24

296. Which one of the following organ of United Nations is known as the 'Policeman of the World'?
A. Security Council
B. International Court of Justice
C. The Secretariat
D. General Assembly

297. The members of the NAFTA include:
A. USA, Canada and Mexico
B. USA, Canada, Mexico and UK
C. USA, UK, Russia and Mexico
D. USA, Canada and Brazil

298. The sits of International Court of Justice is located at :
A. Vienna B. Paris
C. Hague D. New York

299. Which of the following is known as the Constitution of the UN?
A. UN Charter
B. UN Assembly
C. UN Security Council
D. UN Secretariat

300. The Headquarters of the Amnesty International is located at :
A. New York B. London
C. Geneva D. Addis-Ababa

301. Who is the author of the book 'PRISON DIARY'?
A. Bal Gangadhar Tilak
B. Rajendra Prasad
C. Jai Prakash Narayan
D. Jawahar Lal Nehru

302. Who is the author of 'Satanic Verses'?
A. Lewis Carrol B. Salman Rushdie
C. Parry Mason D. Mulk Raj Anand

303. Who wrote 'Gitanjali'?
A. Kalidas
B. Gopal Das 'Neeraj'
C. Rabindra Nath Tagore
D. Jawahar Lal Nehru

304. Who, among the following, scholars flourishing during the Gupta Age, was the author of *Dasakumara-Charita?*
A. Asanga B. Dignaga
C. Dandina D. Bhattin

305. The author of *Gitagovinda* was:
A. Halayudha B. Jayadeva
C. Kalhana D. Jona-raja

306. "Ingenious Pain" is a book/novel written by:
A. Andrew Miller B. Santa Monica
C. Ben Johnson D. Bill Gates

307. Who amongst the following is the author of the famous book "An Equal Music"?
A. Salman Rushdie B. Shasthivrata
C. Vikram Seth D. Kamla Markandeya

308. The famous Moorti Devi Award is given for excellence in which of the following fields?
A. Medicine
B. Science & Technology
C. Social Service
D. Literature

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309. Who has written "Devdas"?
A. Tarasankar Bandyopadhyay
B. Bankim Chandra Chattopadhyay
C. Rabindranath Tagore
D. Sarat Chandra Chattopadhyay

310. "Ain-i-Akbari" is written by:
A. Todar Mal B. Abul Fazal
C. Sheikh Saadi D. Mirza Ghalib

311. "Alice in Wonderland" is written by :
A. Lewis Carrol B. Chester Bowles
C. Charles Dickens D. Jonathan Swift

312. "Mrichchhakatikam" is written by :
A. Vishakhadatta B. Vatsyayana
C. Sudraka D. Bana Bhatt

313. "My Experiments with Truth" is written by :
A. Jawaharlal Nehru
B. M.K. Gandhi
C. Abul Kalam Azad
D. Rajendra Prasad

314. Who wrote the book "India Wins Freedom"?
A. Maulana Abul Kalam Azad
B. Mahatma Gandhi
C. Sir Mohammad Iqbal
D. Abdul Gaffar Khan

315. Match List-I with List-II and select the correct answer using the codes given below the Lists :

List-I	**List-II**
(*a*) *Emma*	1. Graham Greene
(*b*) *Mother India*	2. E.M. Forster
(*c*) *Human Factor*	3. Jane Austen
(*d*) *Passage to India*	4. Katherine Mayo

Codes :

	(*a*)	(*b*)	(*c*)	(*d*)
A.	2	1	4	3
B.	3	4	1	2
C.	3	1	2	4
D.	4	2	1	3

316. 'Poverty and Un British Rule in India' is written by:
A. R.C. Dutt B. J.L. Nehru
C. D.B. Naoroji D. S.N. Sen

317. Name the author of the book *A Passage to England*.
A. E.M. Forster
B. Nirad C. Choudhuri
C. Vikram Seth
D. Eric Segal

318. The author of the book 'The Struggle in My Life' is:
A. Mandela B. J.L. Nehru
C. Tilak D. Gokhale

319. The Shanti Swarup Bhatnagar Award is given by which of the following organisations?
A. Council for Scientific and Industrial Research
B. Indian Council for Agricultural Research
C. Indian National Science Academy
D. Indian Space Research Organisation

320. Which of the following books is not written by Salman Rushdie?
A. The Satanic Verses
B. Shame
C. Naked Face
D. Midnight's Children

321. The different schools of modern socialism derive their strength primarily from the writings of .....?
A. Joseph Stalin B. Leo Tolstoy
C. Mao Tse-tung D. Karl Marx

322. Baba Amte is famous as a .....
A. Painter B. Singer
C. Politician D. Social Worker

323. Central Government says that ..... was received well by citizens as 'imandari ka utsav'.
A. Demonetization
B. Goods and Services Tax
C. E-NAM
D. All of the above

324. Mr. Yehudi Menuhin, was a famous:
A. Sitarist B. Cartoonist
C. Journalist D. Violinist

325. Sundarlal Bahuguna, a famous environ-mentalist, is associated with :
A. Chipko Movement
B. Narmada Bachao Andolan
C. Satyagraha Movement
D. Anti-corruption Movement

326. Mother Teressa's native place was :
A. Albania B. France
C. Greece D. Italy

327. The live polio vaccine which can be taken by mouth was developed by :
A. Albert Sabin B. Edward Jenner
C. Jonas Salk D. Selman Waksman

328. Which one of the following authors put forth the theory of the Drain of India's resources to England?
A. Raja Rammohan Roy
B. Bankim Chandra Chatterjee
C. G.G. Agarkar
D. Dadabhai Naoroji

329. The "Last Supper" is a famous renaissance painting. It was a masterpiece of :
A. Michael Angelo B. Leonardo da Vinci
C. Titian D. Raphael

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330. Dhyanchand is associated with which sports?
A. Badminton B. Hockey
C. Tennis D. Football

331. 'Man is born free, yet every where he is in chains'. This was said by:
A. Voltaire B. John Stuart Mill
C. Rousseau D. Karl Marx

332. Who among the following was a prominent social reformer?
A. Baba Gurmukh Singh
B. Raja Mahendra Pratap
C. Bipin Chandra Pal
D. Jotiba Govind Phule

333. Whose real name was Gadadhar Chhattopa-dhyaya?
A. Swami Vivekanand
B. Ram Krishna Paramhansa
C. Dayanand Saraswai
D. Raja Ram Mohan Rai

334. Who was known as "Man of Destiny"?
A. Napoleon B. Nehru
C. Hitler D. Mussolini

335. Who discovered that mosquito served as a carrier of malaria?
A. Jonas Salk B. Ronald Ross
C. Louis Pasteur D. Robert Koch

336. Who was the first woman Governor of an Indian State?
A. Sushila Nayar
B. Sucheta Kripalani
C. Sarojini Naidu
D. Sulochana Modi

337. Who among the following founded the Bhartiya Jana Sangh?
A. Deen Dayal Upadhyaya
B. Veer Savarkar
C. Dr. Ram Manohar Lohia
D. Dr. Shyama Prasad Mukherjee

338. Who among the following President of India held his office for two successive terms?
A. V.V. Giri
B. Dr. Rajendra Prasad
C. Dr. S. Radhakrishnan
D. None of these

339. Ustad Amjad Ali Khan is an exponent of:
A. Flute B. Sitar
C. Sarod D. Tabla

340. Who is the first non-Indian to receive the Bharat Ratna?
A. Martin Luther King
B. Zubin Mehta
C. Mother Teressa
D. Khan Abdul Ghaffar Khan

ANSWERS

1	2	3	4	5	6	7	8	9	10
B	C	D	C	B	C	A	C	C	D
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
C	A	C	A	A	D	A	B	A	D
21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
A	C	B	C	D	C	B	D	D	B
31	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
C	D	C	C	B	C	D	B	C	C
41	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**
A	A	A	B	C	D	C	B	B	D
51	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**
A	C	A	B	B	A	B	C	A	C
61	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**	**70**
C	C	B	B	C	C	D	D	D	B
71	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**	**80**
B	C	C	C	A	A	A	B	B	A
81	**82**	**83**	**84**	**85**	**86**	**87**	**88**	**89**	**90**
A	B	D	B	C	C	D	C	B	D
91	**92**	**93**	**94**	**95**	**96**	**97**	**98**	**99**	**100**
A	B	A	A	A	B	B	A	A	C
101	**102**	**103**	**104**	**105**	**106**	**107**	**108**	**109**	**110**
C	B	A	D	D	D	A	C	D	C

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111	112	113	114	115	116	117	118	119	120
B	B	B	A	D	C	C	D	B	D
121	**122**	**123**	**124**	**125**	**126**	**127**	**128**	**129**	**130**
C	A	A	B	A	D	C	D	B	D
131	**132**	**133**	**134**	**135**	**136**	**137**	**138**	**139**	**140**
B	B	D	A	B	D	B	D	D	C
141	**142**	**143**	**144**	**145**	**146**	**147**	**148**	**149**	**150**
D	C	D	D	D	B	A	D	C	C
151	**152**	**153**	**154**	**155**	**156**	**157**	**158**	**159**	**160**
A	B	A	A	A	D	C	B	D	A
161	**162**	**163**	**164**	**165**	**166**	**167**	**168**	**169**	**170**
B	B	C	B	D	D	C	B	B	B
171	**172**	**173**	**174**	**175**	**176**	**177**	**178**	**179**	**180**
D	C	D	D	C	B	C	A	D	A
181	**182**	**183**	**184**	**185**	**186**	**187**	**188**	**189**	**190**
B	B	C	A	A	A	B	D	D	A
191	**192**	**193**	**194**	**195**	**196**	**197**	**198**	**199**	**200**
B	C	A	A	D	A	B	D	D	A
201	**202**	**203**	**204**	**205**	**206**	**207**	**208**	**209**	**210**
B	B	B	B	A	A	A	A	A	A
211	**212**	**213**	**214**	**215**	**216**	**217**	**218**	**219**	**220**
B	A	A	A	D	C	D	A	B	B
221	**222**	**223**	**224**	**225**	**226**	**227**	**228**	**229**	**230**
D	C	A	D	A	A	D	D	B	B
231	**232**	**233**	**234**	**235**	**236**	**237**	**238**	**239**	**240**
D	B	D	A	D	D	C	B	B	C
241	**242**	**243**	**244**	**245**	**246**	**247**	**248**	**249**	**250**
D	B	D	C	A	D	D	A	D	A
251	**252**	**253**	**254**	**255**	**256**	**257**	**258**	**259**	**260**
C	D	A	B	C	A	C	C	A	B
261	**262**	**263**	**264**	**265**	**266**	**267**	**268**	**269**	**270**
B	C	C	A	A	C	C	A	C	A
271	**272**	**273**	**274**	**275**	**276**	**277**	**278**	**279**	**280**
B	C	A	B	A	C	B	B	A	B
281	**282**	**283**	**284**	**285**	**286**	**287**	**288**	**289**	**290**
D	A	A	A	B	A	C	B	D	C
291	**292**	**293**	**294**	**295**	**296**	**297**	**298**	**299**	**300**
D	C	B	D	A	A	A	C	A	B
301	**302**	**303**	**304**	**305**	**306**	**307**	**308**	**309**	**310**
C	B	C	C	B	A	C	D	D	B
311	**312**	**313**	**314**	**315**	**316**	**317**	**318**	**319**	**320**
A	C	B	A	B	C	B	A	A	C
321	**322**	**323**	**324**	**325**	**326**	**327**	**328**	**329**	**330**
D	D	A	D	A	A	C	D	B	B
331	**332**	**333**	**334**	**335**	**336**	**337**	**338**	**339**	**340**
C	D	B	A	B	C	D	B	C	D

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CURRENT AFFAIRS

1. Who is the new Chief Minister of Punjab?
A. Baljit Kaur B. Sukhbir Singh Badal
C. Harpal Singh Cheema D. Bhagwant Mann

2. India signed a USD 375 million deal with which nation for the supply of BrahMos missiles?
A. Vietnam B. Indonesia
C. The Philippines D. Brazil

3. Xiomara Castro has become the first-ever female President of which nation?
A. Cuba B. Honduras
C. Mexico D. Colombia

4. Which institute has developed a COVID-19 diagnosis technique using chest X-ray images?
A. IIT Madras B. IIT Kanpur
C. IIT Bombay D. IIT Jodhpur

5. India's first Chief of Defence Staff Bipin Rawat have been posthumously honoured with which among the following awards?
A. Bharat Ratna B. Padma Vibhushan
C. Padma Bhushan D. None of the Above

6. How many aircraft took part in the Republic Day Flypast 2022?
A. 79 B. 75
C. 90 D. 50

7. A part of SpaceX rocket is likely to crash into which among the following?
A. ISS B. Moon
C. Chinese Space Station D. Mars

8. India is ranked second in which among the following ICC Rankings List?
A. ICC T20I Rankings B. ICC Test Rankings
C. ICC ODI Rankings D. ICC U19 Rankings

9. Who is the highest-ranked Indian bowler in ICC Bowler Rankings?
A. R Ashwin B. Jasprit Bumrah
C. Kuldeep Yadav D. Yuzvendra Chahal

10. Who has been named as the captain of the ICC Men's T20I Team of the Year 2021?
A. Virat Kohli B. Joe Root
C. Kane Williamson D. Babar Azam

11. Who is the sole Indian cricketer in the ICC Women's T20 Team of the Year 2021?
A. Mitali Raj B. Harmanpreet Singh
C. Shefali Verma D. Smriti Mandhana

12. Who has named as the captain of the ICC Men's Test Team of the Year 2021?
A. Rohit Sharma B. Kane Williamson
C. Joe Root D. Aaron Finch

13. India will face which nation in its first match of the T20 World Cup 2022?
A. Pakistan B. Sri Lanka
C. Australia D. England

14. Who has been awarded the Best FIFA Men's Player Award 2021?
A. Robert Lewandowski B. Lionel Messi
C. Christiano Ronaldo D. Neymar

15. Who won the Best FIFA Men's Goalkeeper Award 2021?
A. Manuel Neuer B. Alisson Becker
C. Ederson D. Edouard Mendy

16. Cricket team of which country was the first in the world to play 1000th one day international match?
A. India B. Australia
C. England D. Pakistan

17. Which film won the Golden Globe Award 2022 in Best Motion Picture- Drama category?
A. The Power of the Dog B. Belfast
C. King Richard D. Dune

18. Who has been appointed as the new Chief of ISRO?
A. S Somanath B. T. S. Tirumurti
C. V Muraleedharan D. Veerappa Moily

19. Which party wins in UP Assembly Elections 2022?
A. SP B. BJP
C. BSP D. SPSP

20. The government is set to become the single largest shareholder of which telecom company?
A. Vodafone Idea B. Reliance Jio
C. Bharti Airtel D. None of the Above

21. Andhra Pradesh government has increased the retirement age of government staff to how many years?
A. 61 years B. 62 years
C. 64 years D. 65 years

22. David Sassoli, who passed away on January 11th, 2022 was the President of which prominent international body?
A. EU Parliament B. European Union
C. World Bank President D. IMF President

23. Which company a replaced Vivo as the title sponsor of IPL 2022?
A. Reliance B. Vodafone Idea
C. Mahindra & Mahindra D. Tata Group

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24. Dr. Alka Mittal has been appointed as which company's first woman Chairperson and Managing Director?
A. Indian Oil B. ONGC
C. Bharat Petroleum D. Hindustan Petroleum

25. Which bank has enhanced its free IMPS transactions limit to Rs 5 lakh from earlier Rs 2 lakh?
A. SBI B. PNB
C. Canara D. BOB

26. Who among the following has been appointed as a member of England's top royal order, Order of the Garter?
A. Tony Blair B. Theresa May
C. David Cameroon D. Gordon Brown

27. Which nation recorded its first test win over a top-five ICC-ranked team away from home on January 5th, 2022?
A. Ireland B. Scotland
C. Netherlands D. Bangladesh

28. Three-time Olympic triple jump champion Viktor Saneyev passed away on January 3, 2022. He had presented which country at the Olympics?
A. USSR B. USA
C. UK D. Germany

29. Abdalla Hamdok resigned as Prime Minister of which nation on January 2, 2022?
A. Egypt B. Tanzania
C. Sudan D. Yemen

30. Which nation won the ICC Under 19 World Cup 2022?
A. India B. Sri Lanka
C. South Africa D. Australia

31. Which of the following state of India topped in the list of health Index (2019-20) among the large states, recently released by NITI Aayog?
A. Karnataka B. Uttar Pradesh
C. Himachal Pradesh D. Kerala

32. Which of the following state has topped the composite ranking in the Good Governance Index 2021?
A. Uttar Pradesh B. Gujarat
C. Maharashtra D. Goa

33. Which of the following state government has announced 'Tamil Thaai Vaazhthu' as the state song?
A. Tamil Nadu B. Puducherry
C. Kerala D. Andhra Pradesh

34. Which of the following state government has inaugurated 'T-Setu' bridge?
A. Odisha B. West Bengal
C. Andhra Pradesh D. Tamil Nadu

35. "Seven new internet nodes" has been launched in which of the following state?
A. Madhya Pradesh B. Himachal Pradesh
C. Uttar Pradesh D. Rajasthan

36. Which of the following state government has launched Chalo mobile app & smart card for bus travel?
A. Rajasthan B. Maharashtra
C. Uttar Pradesh D. Uttarakhand

37. Union Cabinet has approved a proposal to raise the legal marriage age of women from 18 to how many years?
A. 19 Years B. 20 Years
C. 21 Years D. 22 Years

38. Which is the only state in India where pension for trees is being given?
A. Kerala B. Jharkhand
C. Chhattisgarh D. Haryana

39. A song 'Rashtriya Ekta Geet' composed by the National Cadet Corps (NCC) cadets in 22 language was lauched in December 2021. The song is based on which of the following theme?
A. National Security
B. National Integration
C. National Partition
D. Patriotism

40. In which city All India Mayors' Conference was organized on 17th December 2021 which was inaugurated by PM Modi virtually?
A. Varanasi B. Prayagraj
C. Lucknow D. None of the above

41. Tokenization is an alternative arrangement under which the information related to the cards of banks is stored with the merchant. Which of the following has recently (December 2021) launched tokenization service for Indian Businesses on RuPay?
A. PayPhi B. Google Pay
C. JIO Money D. Payzapp

42. At which citi's Naval Dockyard did Indian Navy recently(December 2021) exhibited the world's largest national flag?
A. Chennai B. Mumbai
C. Vishakhapattnam D. Cochhi

43. Dassault Systèmes has recently(November 2021) signed an MoU with TIDCO to set up 3D EXPERIENCE Innovation Center (Tamil Nadu Center of Advance Manufacturing) at the TIDEL Park in __.
A. Chennai B. Coimbatore
C. Madurai D. Erode

44. Who Inaugrated the 'InFinity Forum', a thought leadership Forum on FinTech on December 3, 2021?
A. Narendra Modi B. Nirmala Sitharaman
C. Harsh Vardhan D. Rajiv Kumar

45. Where is the 5th World Congress on Disaster Management being organized between November 24-27, 2021?
A. Mumbai B. Chennai
C. Ahmedabad D. New Delhi

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46. Which of the following city has been adjudged the cleanest city in India under the Swachh Survekshan 2021?
A. Bhopal B. Indore
C. Lucknow D. Patna

47. How much amount has ADB recently (November 2021) Approved for Water Supply and Sanitation in Uttarakhand?
A. 125 million dollar B. 75 million dollar
C. 50 million dollar D. 25 million dollar

48. On 23 November 2021, the works of the second unit of Buxar Thermal Power Plant were virtually inaugurated. What will be the total power generation from the two units being set up in this power plant?
A. 800 MW B. 1200 MW
C. 1320 MW D. 1450 MW

49. Which country is collaborating with India in the first edition of India Young Water Professional Programme which was launched on 29th November 2021?
A. Australia B. Bangladesh
C. Germany D. Denmark

50. 21st India-Russia Annual Summit was held at which place on 6th December 2021?
A. Moscow B. New Delhi
C. New York D. None of the above

51. On 28 November 2021, which country hosted the 9th meeting of the BIMSTEC Joint Working Group on the topic 'Counter Terrorism and Transnational Crime' was held virtually?
A. Bhutan B. Bangladesh
C. Sri Lanka D. India

52. Where was the first international conference on hydrogen energypolicies, infrastructure development and challenges held from November 24 to 25, 2021?
A. Pune B. New Delhi
C. Kolkata D. Kochi

53. Which of the following films have jointly won the Best Film Award at the 6th BRICS Film Festival?
A. Barakat
B. The Sun above Me Never Sets
C. Asuran
D. Both A & B

54. PANEX-21 which is a HADR (Humanitarian Assistance and Disaster Relief) Exercise is being conducted from 20-22 December 2021 in which city in India?
A. Pune B. Delhi
C. Nagpur D. Kochi

55. The Life Insurance Corporation of India has launched a new savings insurance policy called Dhan Rekha with effect from _____.
A. December 13, 2021 B. December 10, 2021
C. December 09, 2021 D. December 08, 2021

56. Which of the following authority has recently (November 2021) taken over the powers of Reliance Capital Board?
A. RBI
B. SEBI
C. National Company Law Tribunal
D. None of the above

57. Which of the following indigenous company prepared the 155 Multiterrain Artillery Gun (MArG BR) for the Indian Army?
A. Bharat Dynamics limited
B. Bharat electronics Limited
C. Bharat Forge Limited
D. None of these

58. Which of the following space probe of NASA successfully entered the Sun's corona in 2021?
A. Parker B. Juno
C. MAVEN D. Insight

59. On 07 December 2021 from which of the following place DRDO testfired Vertical launch-short range surface-to-air missile (VL-SRSAM)?
A. Chandipur B. Naval Ship
C. Sriharikota D. None of these

60. Asia's biggest Bio-gas plant Gobar-Dhan has been setup in _____.
A. Raipur B. Bikaner
C. Indore D. None of these

61. Where will the Inaugural 2+2 dialogue of the Foreign and Defence Ministers of India and Russia be held on 6th December 2021?
A. Moscow B. New Delhi
C. Dushanbe D. New York

62. Which country has won Davis Cup 2021?
A. India B. USA
C. China D. Russia

63. Who has choosen Miss World 2021?
A. Karolina Bielawaska
B. Shree Saini
C. Geeta Sharma
D. Olivia Yace

64. Which of the following team won SAFF U 19 Women's Championship?
A. India B. Sri Lanka
C. Pakistan D. Bangladesh

65. Lionel Messi has won the Ballon d'Or for a seventh time after being named as the best player in 2021 by France Football. Who is President of France?
A. Emmanuel Macron
B. Vladimir Putin
C. Boris Johnson
D. Justin Trudeau

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66. Which state of India organised Para-Badminton National Championship 2021?
A. Odisha B. Manipur
C. Himachal Pradesh D. Uttar Pradesh

67. Which one of the following has the top searched news event by Indians on Google in 2021?
A. Tokyo Olympics B. Tokyo Paralympic
C. Black Fungus D. Afghanistan news

68. On 16 December 2021, who among the following has become the first and only cricketer in the world to score 2000 runs in T20 in a calendar year?
A. Babar Azam B. Mohammad Rizwan
C. K.L. Rahul D. Aaron Finch

69. Who is the author of the book titled 'Indian Innings: The Journey of Indian Cricket from 1947'?
A. Vinoo Mankad B. Dattu Phadkar
C. Ayaz Memon D. Vijay Hazare

70. Divya Hegde has won the UN Women's Award 2021. What is name of Divya Hegde's organization?
A. Baeru Environmental Services
B. National Organization for Women
C. Women's India Association
D. None of these

71. Who has been named as the Time Person of the Year 2021?
A. Narendra Modi B. Alan Musk
C. Jeff Bezos D. None of these

72. Fortune India released the list of most powerful women in India 2021? Who topped this list?
A. Nita Ambani B. Soumya Swaminathan
C. Nirmala Sitharaman D. Savita Kovind

73. Recently, Who won the Miss Universe 2021 title?
A. Harnaaz Sandhu B. Andrea Meza
C. Nadia Ferreira D. Lalela Mswane

74. On 22 November 2021, Union Home Minister Amit Shah laid the foundation stone of Rani Gaidinliu Tribal Freedom Fighters Museum in Luangkao village of Tamenglong district. In which state is Luangkao village located?
A. Sikkim B. Nagaland
C. Manipur D. Tripura

75. Which person has been appointed as the permanent new Chief Executive Officer of ICC on 21st November 2021?
A. Anil Kumble B. Geoffrey Boycott
C. Geoff Allardyce D. Kane Richardson

76. Consider the following statements:
1. General Bipin Rawat was the First Chief of Defence Staff (CDS)
2. The CDS heads the Department of Military affairs which is to be created within the Ministry of Defence
3. The CDS is the head of the Army, Navy and Air Force and is be a Five star military officer

Which of the following is/are correct?
A. Only 1 B. Both 1 and 2
C. Both 1 and 3 D. All of these

77. In which city was the largest ever drone show of the country organized on the occasion of 75 years of India's independence (Amrit Mahotsav)?
A. Lucknow B. Kanpur
C. Indore D. Bhopal

78. In the Annual General Meeting of Sports Journalists Federation of India on 14th December 2021, it has been decided to confer the prestigious SJFI Medal to whom?
A. Kapil Dev B. Sachin Tendulkar
C. Sunil Gavaskar D. Rahul Dravid

79. Who has been honoured with the 56th Jnanpith Award 2021?
A. Nilmani Phookan Jr B. Damodar Mauzo
C. Both A and B D. None of these

80. Which of the following Indian Mathematician has been honoured with the Ramanujan Prize 2021?
A. Neena Gupta B. Meena Gupta
C. Tina Gupta D. Neena Agarwal

81. Who won African Player of the Year award 2021?
A. Mohamed Salah B. Riyad Mahrez
C. Hakim Ziyech D. Sadio Mane

82. Who has been honoured with the 57th Jnanpith Award 2021?
A. Nilmani Phookan Jr B. Damodar Mauzo
C. Both A and B D. None of these

83. On which date did Chhattisgarh received three prestigious national awards from the Central government for remarkable work done for the welfare and empowerment of Divyangs?
A. 3 December 2021
B. 2 December 2021
C. 1 December 2021
D. None of the above

84. 2021 India-ITU joint Cyber Drill for Indian entities. Who is chief of international telecommunication union?
A. Houllion Zhao B. K Rajaraman
C. Shri R.N jha. D. None of these

85. Which of the following teams won the prestigious Cambrian Patrol Exercise 2021?
A. Canadian Army Team
B. Indian Army Team
C. Australian Army Team
D. Nigerian Army Team

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86. A book titled "India's Ancient Legacy of Wellness" is written by whom?
A. Rekha Chaudhari B. Rekha Sharma
C. Niqi Kundhi D. Smita Thackeray

87. On 6th December 2021, the National Medicinal Plants Board signed an MoU with which of the following to encourage the production of better quality planting material of medicinal plants?
A. National Botanical Research Institute
B. National Center for Research on Plant Biotechnology
C. CSIR-Himalayan Bioresources Institute of Technology, Palampur
D. CSIR-CIMAP, Lucknow

88. Networking platform LinkedIn on December 02, 2021 announced the launch of its Hindi language support that is first Indian regional language on LinkedIn. LinkedIn owned by _
A. Microsoft B. Youtube
C. Adobe D. None of the above

89. Which country is costliest country to live in the world as per the Cost of Living Index 2021?
A. New York B. Tokyo
C. Tel Aviv D. Karachi

90. Which country has decided to close all of its nuclear power plants by 2025?
A. France B. Germany
C. Russia D. Belgium

91. Which state has topped among the Larger States in the NITI Aayog's fourth edition of the State Health Index for 2019-20?
A. Tamil Nadu B. Karnataka
C. Kerala D. Andhra Pradesh

92. Which state has topped among the Smaller States in the NITI Aayog's fourth edition of the State Health Index for 2019-20?
A. Meghalaya B. Mizoram
C. Tripura D. Assam

93. Who has named PETA India's 2021 person of the year?
A. Alia Bhatt B. Anushka Sharma
C. Jacqueline Fernandez D. R Madhavan

94. Which bank has been selected under 'Most Innovative Best Practice' at the coveted CII Digital Transformation Award 2021 or CII DX Award 2021?
A. State Bank of India B. HDFC Bank
C. Union Bank of India D. DBS Bank

95. Which cricket team has won their first ever Vijay Hazare Trophy in 2021?
A. Gujarat B. Karnataka
C. Tamil Nadu D. Himachal Pradesh

96. Who among the following has bagged bronze medal at the International Ski Federation (FIS) Alpine Skiing Competition 2021?
A. Aanchal Thakur B. Akash Kumar
C. Manika Batra D. Archana Kamath

97. "The Turnover Wizard - Saviour Of Thousands" is an autobiography of _____.
A. Pullela Gopichand
B. Amit Ranjan
C. Rakeysh Omprakash Mehra
D. Arup Roy Choudhury

98. Who among the following has authored the book "The Kashmir Conundrum: The Quest for Peace in a Troubled Land"?
A. Manoj Mukund Naravane
B. Shivshankar Menon
C. Nirmal Chander Vij
D. Shyam Saran

99. Which University has won the 'Digital Innovation of the Year Award' in the prestigious Times Higher Education (THE) Asia Awards 2021?
A. Amity University
B. K.R. Mangalam University
C. GD Goenka University
D. O.P. Jindal Global University

100. Who among the following has won the Women's Singles title at BWF World Championship 2021?
A. Sofia Kenin B. Victoria Azarenka
C. Nozomi Okuhara D. Akane Yamaguchi

101. Which of the following city has been adjudged the cleanest city in India under the Swachh Survekshan 2021?
A. Bhopal B. Indore
C. Lucknow D. Patna

102. Which of the following Cricket Team won the T20 World Cup 2021?
A. India B. New Zealand
C. Australia D. England

103. Which of the following city has topped NITI Aayog's inaugural SDG Urban Index and Dashboard 2021–22?
A. Shimla B. Coimbatore
C. Dhanbad D. Kochi

104. Which of the following state ranked first on the IPF Smart Policing Index for 2021?
A. Maharashtra B. Andhra Pradesh
C. Punjab D. Madhya Pradesh

105. Which state has become the first Indian state to ratify tissue culturebased seed potato regulations in November 2021?
A. Punjab B. Haryana
C. Karnataka D. Maharashtra

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106. On November 15, 2021, Prime Minister Narendra Modi dedicated the redeveloped Rani Kamalapati railway station to the nation. What was the past name of this railway station?
A. Ismailganj Railway Station
B. Habibganj Railway Station
C. Nawab Anwaruddin Railway Station
D. Fursatganj Railway Station

107. Which of the following word has been selected as Oxford English Dictionary's 2021 Word of the Year?
A. Climate Emergency B. Vax
C. Toxic D. Self-reliance

108. India and Bangladesh will jointly host the ICC World Cup in which of the following year?
A. 2027 B. 2031
C. 2035 D. 2039

109. Who has won the 2021 Mexico City Grand Prix?
A. Max Verstappen B. Lewis Hamilton
C. Sergio Perez D. None of these

110. Who has/have been honoured with Inter-national Press Institute award for Excellence in Journalism 2021?
A. Sreenivasan Jain B. Mariyam Alavi
C. Both A & B D. Ritika Chopra

111. Who have been awarded as Nobel Peace Prize 2021?
A. Mahatma Gandhi B. Donald Trump
C. Maria Ressa D. Dmitry Muratov

112. Consider the following statements:

(*i*) United states-based scientist, David Julius and Ardem Patapoutin, have been awarded the 2021 Nobel Prize for Physiology/Medicine.

(*ii*) They have been awarded the prize for their discoveries of receptors for temperature and touch.

Which of the above are true?
A. (*i*) B. (*ii*)
C. (*i*) and (*ii*) both D. None of the above

113. Who has won Nobel for Chemistry in 2021?
A. Benjamin List B. David MacMillan
C. Both A and B D. None of the above

114. Which of the following has won the Nobel Prize in Economics in 2021?
A. David Card B. Joshua D. Angrist
C. Guido W. Imbens D. All of the above

115. Which of the following person has won the Nobel prize in literature in 2021?
A. Abdulrazak Gurnah B. W.C. MacMillan
C. Benjamin List D. All of the above

116. Who won the Nobel prize in physics in 2021?
A. Syukuro Manabe B. Klaus Hasselmann
C. Giorgio Parisi D. All of the above

117. The National Infrastructure Fund will invest in areas such as water, transportation, energy, and health, contributing to transform the economy and make it less reliant on oil revenue. Which country has recently (October 2021) launched this fund?
A. Saudi Arabia B. Kuwait
C. Qatar D. Libiya

118. The Supreme Court in 2021 appointed an independent expert technical committee to examine allegations that the government used an Israeli spyware, Pegasus, to snoop on its own citizens. Who is heading the committee?
A. Home Minister Amit Shah
B. CJI N.V. Rammana
C. Former SC judge, Justice R.V. Raveendran
D. None of the above

119. Which country hosted the 16th East Asia Summit?
A. Brunei B. Singapore
C. Malaysia D. Indonesia

120. Union Road Transport and Highways Minister Nitin Gadkari has announced naming of which new National Highway as "Shri Guru Nanak Dev Ji Marg."
A. 703 AA B. 367
C. 275 D. 235

121. Which company has launched India's first card-on-file tokenization service in October 2021?
A. Visa B. MakeMyTrip
C. Mastercard D. None of the above

122. Prime Minister Narendra Modi listed four ways to boost the tourism sector in the country:
I. Cleanliness II. Comfort
III. Facilities IV. Time
V. Thinking
A. Only I, II, III and IV
B. Only I, III, IV and V
C. Only II, III, IV and V
D. Only I, II, IV and V

123. Which ministry has recently launched a podcast on Freedom movement called "Amrit Mahotsav Podcast"?
A. Ministry of Tourism
B. Ministry of Information and Boadcasting
C. Ministry of Culture
D. None of the above

124. Which city hosted National Tribal Dance Festival from 28 to 30 October, 2021?
A. Delhi B. Lucknow
C. Raipur D. Jaipur

125. On 25th October 2021 PM Modi launched Ayushman Bharat Health Infrastructure Mission from which place?
A. Delhi B. Lucknow
C. Varanasi D. None of the above

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126. On which date 'PM Ayushman Bharat Health Infrastructure Mission' launched by Prime Minister?
A. October 25 B. October 24
C. October 23 D. October 22

127. Which of the following company launched recently a special Azadi Amrit Chai to commemorate the 75th year of India's Independence?
A. TATA
B. Maharani
C. M/s Andrew Yule and Company Limited
D. None of these

128. On which of the following date National Police Commemoration Day is observed?
A. 21 October
B. 25 October
C. First Sunday of October
D. 21 November

129. Which state has recently got GI tag for Kanyakumari clove?
A. Kerala B. Tamil Nadu
C. Telangana D. Karnataka

130. Which state/UT government has launched 'Desh Ke Mentor' Programme recently?
A. Delhi B. Uttar Pradesh
C. Rajasthan D. Tamil Nadu

131. NITI Aayog has collaborated with which other organization to launch a handbook on Sustainable urban plastic waste management?
A. United Nation World Food Program
B. United Nation Development Program
C. TERI
D. None of the above

132. Which of the following state has became 1st state to organised cultivation of dalchini?
A. Uttarakhand B. Sikkim
C. Arunachal Pradesh D. Himachal Pradesh

133. The union cabinet has approved a proposal for setting up seven mega integrated textile parks in order to generate employment and attract investments for the sector, Union Ministers Anurag Thakur and Piyush Goyal announced on which date?
A. 6th October 2021 B. 30th September 2021
C. 14th October 2021 D. None of the above

134. On 5th October 2021 which organization has released "State of the Education Report (SOER)-2021 for India: No Teachers, No Class"?
A. NITI Aayog B. UNESCO
C. World Bank D. IMF

135. Which nation hosted the 16th East Asia Summit held virtually on 27th October 2021?
A. India B. Brunei
C. China D. Indonesia

136. 10th edition of the Global Food Security Index was published recently. India is ranked at what position on 2021 Global Food Security Index?
A. 71st B. 102nd
C. 89th D. 61st

137. Which of the following country has launched the world's first selfdriving train?
A. China B. USA
C. Japan D. Germany

138. The seventh G-20 Parliamentary Speakers Summit held on October 7-8, 2021 held in which city?
A. New York, USA B. New Delhi, India
C. Italy, Rome D. None of these

139. Which organization has recently released 'The Changing Wealth of Nations 2021 report'?
A. NITI Aayog B. IMF
C. World Bank D. WTO

140. Which district of West Bengal has been awarded with GI tag for sweet dish 'Mihidana' recently?
A. Kolkata B. Malda
C. Hugli D. Bardhaman

141. On 11 October, 2021 who launched the Indian Space Association (ISpA), the premier industry association of space and satellite companies?
A. Shri Narendra Modi
B. Gen Bipin Rawat
C. Shri K. Sivan
D. President Ram Nath Kovind

142. World's largest cricket bat has been unveiled by which of the following former Indian Cricketer?
A. Rahul Dravid
B. Sachin Ramesh Tendulkar
C. Sunil Gavaskar
D. Mohd Azharuddin

143. Which of the following team won the IPL 2021?
A. Chennai Super Kings
B. Kolkata Knight Riders
C. Delhi Capitals
D. Royal Challengers Bangalore

144. Indian men's team won which of the following medal in Asian Table Tennis Championship 2021?
A. Gold B. Silver
C. Bronze D. None of these

145. Which of the following organisation held the Dare to Dream 2.0' Contest in India?
A. ONGC B. DRDO
C. IPL D. BCCI

146. Who was the most-searched person on Google in India in 2021?
A. Neeraj Chopra B. Aryan Khan
C. Shehnaaz Gill D. Elon Musk

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147. Which country won the FIH Men's Hockey World Cup 2021?
A. Argentina B. Germany
C. France D. Spain

148. India finished at which place in the FIH Men's Junior Hockey World Cup 2021?
A. Third B. Fourth
C. Fifth D. Sixth

149. Chamba chappal, Lahaul's knitted socks, gloves get GI tag both products are belong by which state of India?
A. Himachal Pradesh B. Delhi
C. Uttarakhand D. Bihar

150. Which of the following country has named its critically endangered long-tailed bat as the Bird of the Year 2021?
A. USA B. New Zealand
C. Australia D. India

151. Which of the following monuments has been included in UNESCO's world heritage site list in July 2021?
A. Kakatiya Rudreshwara (Ramappa) Temple
B. Meenakshi temple, Madurai
C. Dholavira : A Harappan City
D. Both (A) and (C)

152. Who amongst the following was the first Indian to win a medal in XXXII Olympics held at Tokyo (Japan July 2021)?
A. Meerabai Chanu
B. Lavlina Borgohain
C. PV Sindhu
D. Ravi Kumar Dahiya

153. Bhoot Jolokia is a species of red chilly of:
A. Nagaland B. Mizoram
C. Andhra Pradesh D. Telangana

154. Which day was observed as "Muslim Women Rights Day" in India?
A. 1st May, 2018 B. 1st June, 2019
C. 1st July, 2020 D. 1st August, 2021

155. Which of the following statements is correct about 'Clone Trains'?
A. Toy trains in amusement parks are known as 'Clone Trains'
B. As on July 26, 2021, 22 Clone Trains were being operated by Indian Railways
C. Indian Railways operates special trains on routes where traffic demand is high
D. Both (B) and (C)

156. At present (August 1, 2021) metro rail/Regional Rapid Transit System (RRTS) are neither operational nor under implementation in which state?
A. Rajasthan B. Kerala
C. Punjab D. Madhya Pradesh

157. Rajiv Gandhi Khel Ratna award rechristened as:
A. Major Dhyan Chand Khel Ratna Award
B. Balbir Singh Sr Khel Ratna Award
C. Dhanraj Pillai Khel Ratna Award
D. Zafar Iqbal Khel Ratna Award

158. PM Narendra Modi chaired UN Security Council meet on August 9, 2021 on which of the following issues?
A. Terrorism and internal security
B. Use of biological weapons : A grave threat to humanity
C. Rising conflicts among nations
D. Maritime security

159. Which of the following pairs is not matched correctly in relation to Olympic events?
A. Olympic 2020 – Tokyo (Japan)
B. Olympic 2024 – Paris (France)
C. Olympic 2028 – Los Angeles (USA)
D. Olympic 2036 – Rome (Italy)

160. Who was the captain of Indian Hockey team that won a bronze medal in just concluded Tokyo Olympic 2020?
A. Manpreet Singh B. P.R. Sreejesh
C. Shamser Singh D. Gurjant Singh

161. Which of the following Olympians has been made brand ambassador of Uttarakhand State for its Women and Child Development Department as well as Centre's 'Beti Bachao Beti Padhao' scheme?
A. Vandana Kataria B. Rani Rampal
C. Gurjit Kaur D. Deepa Grace Ekka

162. Which of the following States sponsored India's Men's Hockey Team and Women's Hockey Team?
A. West Bengal B. Odisha
C. Haryana D. Jharkhand

163. Which of the following players won maximum gold medals in the Tokyo Olympic 2020?
A. Cealeb Dressel (USA)
B. Emma Mckeon (Australia)
C. An San (Japan)
D. Vitalina Batsarashkina (Russia)

164. Which day was observed in India in the year 2021 as the 'Partition Horrors Remembrance Day'?
A. August 12, 2021 B. August 13, 2021
C. August 14, 2021 D. August 16, 2021

165. India won Lords Test on August 16, 2021 defeating England by 151 runs. It was India's ..... victory at Lords against the hosts.
A. 2nd B. 3rd
C. 4th D. 5th

166. Which state government has decided to shun the usage of the term 'Central Government' in its official communication and replaced it with 'Union Government'?
A. Kerala B. West Bengal
C. Tamil Nadu D. Punjab

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167. At least five police personnel were killed in a violent border dispute between:
A. Assam and Arunachal Pradesh
B. Assam and Nagaland
C. Assam and Mizoram
D. Arunachal Pradesh and Nagaland

168. Which of the following is the only DNA-based vaccine in the world that can be administered without a needle, purportedly minimising chances of reactions?
A. Covishield B. Covaxin
C. Sputnik V D. Zycov-D

169. The term 'SPARSH' is related to:
A. Rehabilitation of visually impaired persons
B. Rehabilitation of leprosy patients
C. System for Pension Administration Raksha
D. Reduction in the Neonatal Mortality rate

170. 'Operation Devi Shakti' is related to:
A. Empowerment of Women of nomadic tribes
B. Uttar Pradesh Government's initiative to develop 'devi circuits'
C. Mass scale training of women representa-tives of Panchayati Raj Institutions
D. India's complex mission to evacuate its citizens and Afghan partners from Kabul after its swift takeover by the Taliban

171. How many medals have been won by India at the Tokyo Paralympics 2020?
A. 15 B. 17
C. 18 D. 19

172. Which player has won the F1 Dutch Grand Prix 2021?
A. Lewis Hamilton
B. Max Verstappen
C. Valtteri Bottas
D. Sebastian Vettel

173. Which country has topped the medal tally at the 2020 Summer Paralympics at Tokyo?
A. China B. Great Britain
C. Japan D. Australia

174. What is the rank of India at the 2020 Summer Paralympics at Tokyo?
A. 48 B. 24
C. 56 D. 33

175. Praveen Kumar has claimed a silver medal in which event at the Tokyo Paralympics Games?
A. Discuss Throw B. Shotput
C. High Jump D. Javelin Throw

176. Name the Indian para-athlete who has won two medals at the ongoing Tokyo Games in Shooting event.
A. Mariyappan Thangavelu
B. Sharad Kumar
C. Devendra Jhajharia
D. Avani Lekhara

177. Which medal has India won at the Tokyo Olympics 2020 in Mens Hockey?
A. Silver B. Gold
C. Bronze D. No medal

178. Which team has India defeated to reach the Semi Finals of Olympics Hockey 2020?
A. Japan B. Britain
C. China D. Pakistan

179. When was the opening ceremony of the Tokyo Olympic Games?
A. July 22nd B. July 23rd
C. July 24th D. July 25th

180. What was the size of the Indian contingent at the Tokyo Olympics 2020?
A. 228 B. 336
C. 248 D. 196

181. Which among the following badminton player failed to qualify for the Tokyo Olympics?
A. Saina Nehwal B. PV Sindhu
C. B Sai Praneeth D. Chirag Shetty

182. Which among the following tennis players did not play at the Tokyo Olympics?
A. Rohan Bopanna B. Sania Mirza
C. Ankita Raina D. Sumit Nagpal

183. Who was the sole representative of India in the Women's Artistic event?
A. Annu Rani B. Maana Patel
C. Pranati Nayak D. Priyanka Goswami

184. Which state has the highest number of tigers in India?
A. Kerala B. Uttarakhand
C. Madhya Pradesh D. Karnataka

185. Which star Indian track and field athlete missed out on qualification in the Tokyo Olympics 2020?
A. Dutee Chand B. Hima Das
C. Seema Punia D. Kamalpreet Kaur

186. Which among the following sports made its debut at Olympics 2020?
A. Karate B. Fencing
C. Judo D. Equestrian

187. Which among the following sports returned to the Olympics 2020 after being cut out previously?
A. Baseball B. Golf
C. Judo D. Fencing

188. Who is the composer and singer of the theme song for the Indian Paralympic contingent 'Kar De Kamaal Tu'?
A. Vikrant Keni B. Gurudas Raut
C. Ravi Chauhan D. Sanjeev Singh

189. Neeraj Chopra claimed gold medal for India in Tokyo Olympics in which event?
A. Boxing B. Shooting
C. Wrestling D. Javelin throw

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190. Tokyo Olympic is _____ th edition of Summer Olympics.
A. 32 B. 31
C. 33 D. 30

191. Which Indian woman Gymnast has represented India at Tokyo Olympics 2020?
A. Pranati Nayak B. Sunita Sharma
C. Dipa Karmakar D. Aruna Reddy

192. What do the five rings on the Olympic symbol represent?
A. the five oceans B. the five continents
C. the five countries D. the five rivers

193. Who among the following has been honoured with the Subhash Chandra Bose Apda Prabandhan Puraskar 2022?
A. Kumar Munnan Singh
B. Dr. Rajendra Kumar Bhandari
C. Prof. Vinod Sharma
D. None of the above

194. Which team leads the procession of athletes at the opening ceremony of the Olympic Games?
A. Hosting nation
B. Greece
C. Hosting nation of next 2 Olympic games
D. Hosting nation of previous 3 Olympic games

195. Which country in November, 2021 denied permission to use its airspace for India's Go First airlines flight from Srinagar to Sharjah?
A. Oman B. Afghanistan
C. Pakistan D. None of the above

196. Who was the youngest athlete in the Tokyo Olympic 2020?
A. Hend Zaza B. Mollie O'Callaghan
C. Nino Salukvadze D. Andrew Hoy

197. Tokyo Paralympics Games how many sports are to be played?
A. 20 B. 22
C. 24 D. 26

198. What was the mascot of Tokyo Paralympics 2020 games?
A. Miratowa B. Someity
C. Vinicius and Tom D. Appu

199. Totally how many athletes from India had participated in the Tokyo Paralympics 2020 games?
A. 50 B. 52
C. 54 D. 56

200. What was the main motto of Tokyo Paralympics Games?
A. United by Nations B. United by Emotions
C. United by Motions D. United by Games

201. In the Tokyo Paralympics 2020 which nation has the biggest contingent in terms of number of athletes participating?
A. China B. USA
C. UK D. Brazil

202. Which state of India topped in Logistics Index 2021?
A. Chhattisgarh B. Maharashtra
C. Rajasthan D. Gujarat

203. Flag bearer Mariyappan Thangavelu from India at Tokyo Paralympics belongs to which sport?
A. Long Jump B. Javelin Throw
C. High Jump D. Swimming

204. Which nation withdraws from the Tokyo Paralympics 2020 due to instability and violence?
A. Syria B. Afghanistan
C. Iraq D. Myanmar

205. Who is India's women's Power lifting 50 kg participant at Tokyo Paralympics 2020?
A. Sakina Khatun B. Palak Kohli
C. Prachi Yadav D. Parul Parmar

206. Who among the following has taken the charge as 21st Director General of Assam Rifles?
A. MA Ganapathy
B. Kuldiep Singh
C. Surjeet Singh Deswal
D. Pradeep Chandran Nair

207. Who has assumed charge as the Deputy Chief of Naval Staff?
A. Ravneet Singh B. Anup Kumar Singh
C. AP Maheshwari D. Samant Goel

208. Name the Indian boxer who has won the gold in 91 kg category in Asian Boxing Championships 2021.
A. Sanjeet Kumar B. Amit Panghal
C. Shiva Thapa D. Manish Kaushik

209. _____ is an automated electronic payment service which allows you to make monthly payment to the billing organisation (BO) from your bank account directly.
A. LIFO B. FIFO
C. GIRO D. RIGO

210. Pooja Rani has recently won the gold medal for India in which sports event?
A. Wrestling B. Shooting
C. Boxing D. Sprinting

211. A Group of Ministers (GoM) has been constituted by GST Council to examine GST exemption on Covid-19 relief materials. Who is the chairperson of this panel?
A. Goa Chief Minister
B. Haryana Chief Minister
C. Uttar Pradesh Chief Minister
D. Meghalaya Chief Minister

212. Who is the author of the book "LANGUAGES OF TRUTH: Essays 2003-2020"?
A. V.S. Naipaul B. Salman Rushdie
C. Arundhati Roy D. Kiran Desai

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213. Who has been appointed as the new Director General of National Investigation Agency (NIA)?
A. Samant Goel
B. Arvind Kumar
C. Subodh Kumar Jaiswal
D. Kuldeep Singh

214. Tata Consultancy Services (TCS) has opened its first European innovation centre in ____.
A. Rome, Italy
B. Atlanta, Georgia, United States
C. Glasgow, Scotland
D. Amsterdam, Netherland

215. Who has been awarded with 'WHO Director-General Special Recognition Award' for his efforts in tobacco control?
A. Shripad Yesso Naik
B. Harsh Vardhan
C. K K Shailaja
D. Ashwini Kumar Choubey

216. The world's first human case of H10N3 Bird Flu has been reported in which nation?
A. China B. Singapore
C. Japan D. Malaysia

217. Who won the prestigious Ballon d'Or award 2021 for best male footballer of the world?
A. Cristiano Ranaldo (Portugal)
B. Lewandowski (Poland)
C. Lionel Messi (Argentina)
D. Neymar da Silva Santos Junior (Brazil)

218. _____ along with Jerry Wind won the International Business Book of the Year Award 2021 for their book _____.
A. Salil Parekh; Winning Now, Winning Later
B. Nitin Rakesh; Transformation in Times of Crisis
C. Salil Parekh; The Passion Economy
D. Nitin Rakesh; Winning Now, Winning Later

219. "Bal Swaraj", a digital real-time tracking and monitoring platform was launched to protect Children who lost their parents in COVID-19. Which organisation launched the portal?
A. National Human Rights Commission of India
B. Rashtriya Mahila Kosh
C. Central Adoption Resource Authority
D. National Commission for Protection of Child Rights

220. On the occasion of World Environment Day, PM Modi has launched three E 100 ethanol dispensing stations under a pilot project in which city?
A. Hyderabad B. Ahmedabad
C. Pune D. New Delhi

221. G-20 Summit 2021 was held on 30th-31st October, 2021 in:
A. Rome (Italy) B. Glasgow (UK)
C. Chicago (USA) D. Perth (Australia)

222. Name the winner of the prestigious 2021 Nature TTL Photography Awards.
A. Auditya Venkatesh
B. Sudhir Shivaram
C. Thomas Vijayan
D. Murad Osmann

223. India has signed a loan agreement with ADB for upgrading major district roads in _____.
A. Sikkim B. Assam
C. Tripura D. Nagaland

224. Which scheme has been launched in Ladakh for encouraging students to adopt digital learning?
A. YouthTab B. YounTab
C. EduTab D. OnlineTab

225. _____ has acquired online medicine platform Medlife.
A. 1 mg B. PharmEasy
C. Netmeds D. Jio Mart

226. The Mission Innovation CleanTech Exchange has been launched by which country?
A. Russia B. United States
C. Japan D. India

227. The 'YounTab' Scheme has been launched by which state/UT of India?
A. Ladakh B. Assam
C. Chandigarh D. Sikkim

228. Name the Indian organisation which has recently become the signatory to the prestigious UN Global Compact's CEO Water Mandate, that focus on efficient water management?
A. SAIL B. State Bank of India
C. NTPC D. LIC

229. Name the winner of the International Business Book of the Year Award for 2021?
A. Neerja Sethi and Megan Beck
B. Ganesh Ayyar and Paul Green
C. Prashant Ranade and Barry Libert
D. Nitin Rakesh and Jerry Wind

230. Who among the following has approved the $500 million program to help boost India's MSME sector?
A. United Nations
B. World Trade Organization
C. World Bank
D. World Health Organization

231. Facebook India has launched Tech Scholars Programme for the ____ students for research and mentorship.
A. Engineering B. Medical
C. Law D. Fine Arts

232. In which place 24th Winter Olympics held in February 2022?
A. Beijing B. Rotterdam
C. Acapulco D. Antigua

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233. The mobile app "Namaste Yoga", devoted to Yoga, has been launched by which Ministry?
A. Ministry of AYUSH
B. Ministry of Youth Affairs and Sports
C. Ministry of Health and Family Welfare
D. Ministry of Defence

234. Who has been appointed as the new Secretary General of the United Nations Conference on Trade and Development (UNCTAD)?
A. Enrique Iglesias
B. Arnoldo Lopez Echandi
C. Maria Eugenia Casar
D. Rebeca Grynspan

235. The Mission 'EnVision', to study the planet Venus, has been launched by which space agency?
A. NASA
B. European Space Agency (ESA)
C. ISRO
D. Roscosmos

236. Who has been appointed as the new Chief of the Air Staff?
A. Amitabh Chaudhry
B. Rajesh Bindal
C. V.R. Chaudhari
D. Prafulla Chandra Pant

237. Who among the following has won Pulitzer Prize 2021 in the "Fiction" Category for the book The Night Watchman?
A. Louise Erdrich B. Wesley Morris
C. Robert Greene D. Katori Hall

238. India is _____ most charitable country, according to World Giving Index 2021 report.
A. 14th B. 12th
C. 16th D. 19th

239. "Believe—What Life and Cricket Taught Me" is the autobiography of which of the following cricketer?
A. Yuvraj Singh B. Gautam Gambhir
C. Harbhajan Singh D. Suresh Raina

240. Who has been appointed as the Prime Minister of Central African Republic?
A. Henri Dondra B. Firmin Ngrebada
C. Okonjo Iweala D. Assimi Goita

241. Which state has launched a mobile app PRAGYAAM to issue e-passes to everyone associated with delivery of essential services?
A. Bihar B. Uttar Pradesh
C. Jharkhand D. Gujarat

242. Which day will be observed in India as 'Veer Baal Diwas'?
A. November, 14 B. January, 9
C. January 14 D. December 26

243. Which IIT institution has built a mobile app named 'CORONTINE'?
A. IIT Bombay B. IIT Roorkee
C. IIT Gandhinagar D. IIT Hyderabad

244. The Government of India has sold its stake in THDC India Ltd and NEEPCO (North Eastern Electric Power Corp) to which Indian public sector undertaking?
A. ONGC B. SAIL
C. GAIL D. NTPC

245. Which ministry has launched a portal 'Stranded in India' to help foreign tourists who are stuck in various parts of the country?
A. Ministry of Home Affairs
B. Ministry of External Affairs
C. Ministry of Tourism
D. Ministry of Law and Justice

246. China has identified "Tan Re Qing" as best cure for COVID-19, this traditional medicine carries the bile of which animal?
A. Deer B. Bear
C. Rabbit D. Sheep

247. Who is the author of the book *The Death of Jesus*?
A. Paul Celan B. J M Coetzee
C. Albert Camus D. Arundhati Roy

248. As per the latest UNCTAD report, the world economy will go into recession with the exception of which two countries?
A. China & Japan B. United States & China
C. India & China D. South Korea & China

249. India's rank in TRACE Global Bribery Risk Ranking 2021 is:
A. 77th B. 90th
C. 82nd D. 102nd

250. Tata Power JV commission has started commercial operation of a 178 megawatt hydropower project in which country?
A. Armenia B. Georgia
C. Turkey D. Russia

251. Which Space Agency has announced the SunRISE mission to study giant solar particle storms?
A. ISRO B. JAXA
C. Roscosmos D. NASA

252. Which Indian newspaper that used to get published in the United States for 50 years has ceased its printed edition?
A. India Bulletin B. India Currents
C. Biz India D. India Abroad

253. The 5th world congress on Disaster Management was organised in November 2021 in:
A. New Delhi B. Tokyo
C. Perth D. Auckland

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254. Birju Maharaj, a classical dancer of world repute died on January 17, 2022. He was exponent of:
A. Bharatnattyam B. Odishi
C. Kathak D. Kathakali

255. Which state has launched a mobile application 'Corona Watch'?
A. Andhra Pradesh B. Madhya Pradesh
C. Rajasthan D. Karnataka

256. S-400 Triumf missile defence system is being acquired by India from:
A. The USA B. The UK
C. France D. Russia

257. Which company has acquired a popular weather app Dark Sky?
A. Samsung B. Apple
C. Facebook D. Google

258. What is the full form of MOM which is designed by the personnel from Naval Dockyard in Vishakhapatnam?
A. Many-feed Oxygen Meter
B. Micro-feed Oxygen Manifold
C. Multi-feed Oxygen Manifold
D. Many-free Oxygen Meter

259. India and which country have postponed all the events planned to celebrate the 70th anniversary of their diplomatic relations due to COVID-19?
A. China B. Japan
C. Russia D. Israel

260. Which state will distribute 25 lakh houses sites to poor under Navaratnalu - Pedalandariki Illu (houses for all the poor) programme?
A. Tamil Nadu B. Andhra Pradesh
C. Odisha D. Telangana

261. Insurance Australia General (IAG) has sold its entire 26% stake held in which Insurance company of India?
A. Tata AIG General Insurance
B. Oriental Insurance Company
C. SBI General Insurance
D. ICICI Lombard

262. As per the notification by GoI, any person who has resided in J&K for the period of _____ years would be considered as domicile of J&K?
A. 10 years B. 15 years
C. 12 years D. 20 years

263. As per the state of forest report 2021 data, total area under forest cover and tree cover in India is:
A. 76.6238 million hectares
B. 80.9537 million hectares
C. 79.8182 million hectares
D. 50.1698 million hectares

264. Name the woman who is behind India's first testing kit Patho Detect?
A. Minal Dakhave Bhosale
B. Gita Ramjee
C. Radhika Sharma
D. Anjali Patil

265. One of the men behind the Duckworth-Lewis-Stern (DLS) passed away recently, what was his name?
A. Tony Lewis B. Frank Duckworth
C. Nat Thomson D. William Cooper

266. 52nd International Film Festival of India was organized in which place?
A. Mumbai B. Hyderabad
C. New Delhi D. Panaji

267. Which bank has listed Green Bonds of $100 million on India INX's Global Securities Market Green Platform (GSM)?
A. State Bank of India B. Axis Bank
C. HDFC Bank D. Punjab National Bank

268. As per the recent changes in the direct tax regime, what is the number of days NRIs needed to spend in India to qualify as Indian tax resident?
A. 120 days B. 182 days
C. 160 days D. 150 days

269. The Civil Aviation Ministry under which initiative is supplying medical and essential supplies across the country?
A. Sanjeevani Udan B. Lifeline Udan
C. Covid Udan D. Life Udan

270. The government of India has announced setting up of a "cargo air-bridge" with which country to transport critical medical supplies?
A. Russia B. Maldives
C. Sri Lanka D. China

271. Which country hosted the third edition of the Asian Youth Games in November 2021?
A. South Korea B. Vietnam
C. Japan D. China

272. Which state has launched an online cultural competition "Mo Prativa" in collaboration with the UNICEF?
A. Karnataka B. Andhra Pradesh
C. Odisha D. Himachal Pradesh

273. What is the name of the mascot chosen for the 19th Asian Games scheduled to be held in 2022?
A. Dragon B. Cobi & Petra
C. Oski D. Smart Triplets

274. Which manufacturing unit of Indian Railways has set the Limca Book of Records for producing record 431 locomotives in the FY20 in 292 working days?
A. Diesel Locomotive Works (DLW)
B. Integral Coach Factory (ICF)
C. Chittaranjan Locomotive Works (CLW)
D. Rail Coach Factory (RCF)

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275. Which Indian NGO been awarded the Skoll Award for Social Entrepreneurship 2020 for its exceptional work in the maternal and child health space in India?
A. Goonj B. ARMMAN
C. PEHAL D. Deepalaya

276. Associations representing officers of Central Civil Services, including IAS and the IPS, have launched which initiative to support government's efforts in fighting coronavirus?
A. Prerna B. Samvedhna
C. Anukampa D. Caruna

277. ICICI Securities (I-Sec) has partnered with N.S. Raghavan Centre of Entrepreneurial Learning (NSRCEL) to support startups in the fintech space. NSRCEL is start up hub of which IIM institution?
A. IIM Ahmedabad B. IIM Indore
C. IIM Banglore D. IIM Lucknow

278. National Cadet Corps (NCC) has offered its volunteer cadets for national duty to fight COVID-19 under which initiative?
A. Exercise NCC Yogdan B. Project NCC Saathi
C. Exercise NCC Karma D. Target NCC Covid

279. CCI has approved acquisition of 18.95 per cent stake in which health Insurance company by Trishikhar Ventures under the green channel route?
A. Religare B. Apollo Munich
C. Future Generali India D. Max Bupa

280. IISc Bengaluru has developed a prototype of an indigenous ventilator under which project?
A. Raksha B. Vaayu
C. Praana D. Umeed

281. JEEVAN, is a low-cost energy efficient ventilator made by the Rail Coach Factory, located in which city?
A. Lucknow B. Raebareli
C. Tiruchirapalli D. Kapurthala

282. Name the Chief Minister of India who was conferred with the 'Hero to Animals Award' by PETA India?
A. Arvind Kejriwal B. Pema Khandu
C. Bhupesh Baghel D. Naveen patnaik

283. Who won the 5th World Chess Championship?
A. Ian Nepomniachtchi B. Magnus Carlsen
C. Viswanathan Anand D. Sergey Karjakin

284. Which country becomes world's first country to introduce 4 and half day work week?
A. Norway B. Brazil
C. Cuba D. United Arab Emirates

285. UB Pravin Rao has been appointed as the Chairman of which company?
A. NASSCOM B. Infosys
C. Wipro D. ASSOCHAM

286. The union cabinet has suspended the MP Local Area Development (MPLAD) scheme for how many years?
A. 3 years B. 1 year
C. 2 years D. 4 years

287. Which IIT institutions has developed a low-cost portable ventilator Prana-Vayu in association with AIIMS-Rishikesh?
A. IIT Mandi B. IIT Roorkee
C. IIT Kharagpur D. IIT Gandhinagar

288. As per the recent survey, conducted by which organization, about one-fourth of the consumers in India currently pay for news?
A. World Economic Forum
B. National Sample Survey Office
C. World Trade Organization
D. Press Trust of India

289. Which company has decided to shut down its 'Neighbourly' app?
A. Facebook B. Wipro
C. Google D. Microsoft

290. Harnaaz Sandhu of India has been crowned the 70th Miss Universe. The pageant was held on December 12, 2021 in:
A. Paris (France) B. Seoul (South Korea)
C. Eilat (Israel) D. Copenhagen (Denmark)

291. The 4th Anniversary of launch of Shyama Prasad Mukherji Rurban Mission was observed on which date?
A. 20 February B. 21 February
C. 22 February D. 19 February

292. Which country has formally announced its decision to withdraw from the United Nations Human Rights Council (UNHRC) resolution co-sponsored in 2015?
A. India B. Britain
C. Sri Lanka D. Canada

293. The eighth edition of Ganga Kayak Festival was inaugurated in which state?
A. Uttarakhand B. Bihar
C. Uttar Pradesh D. West Bengal

294. Which state has announced a 50 per cent subsidy for 'Ulemas' to buy new two-wheelers?
A. Kerala B. Madhya Pradesh
C. Karnataka D. Tamil Nadu

295. Which state will soon open Atal Kisan – Majdoor canteens in all mandis and sugar mills across the state?
A. Punjab B. Haryana
C. Rajasthan D. Bihar

296. Which state of India topped in Logistics Index 2021?
A. Tripura B. Nagaland
C. Sikkim D. Gujarat

297. Who has become only the second Indian woman to win a gold medal at the Asian Wrestling Championships?

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A. Navjot Kaur B. Sarita Mor
C. Divya Kakran D. Nirmala Devi

298. Who has won the ESPN's Female Sportsperson of the Year award?
A. Saina Nehwal B. PV Sindhu
C. Hima Das D. Mary Kom

299. Which state government has ordered the destruction of the Thai Mangur fish breeding centres?
A. Maharashtra B. West Bengal
C. Odisha D. Tamil Nadu

300. Which country has created the Food Planet Prize?
A. Canada B. Australia
C. Sweden D. France

301. Who won Australian Open Grand Salam Men's single title 2022?
A. Rafael Nadal B. Daniil Medvedev
C. Roger Federer D. Novak Djokovic

302. Which state's consumers will now get financial compensation for delay in resolving their complaints by the electricity department?
A. Madhya Pradesh B. Uttar Pradesh
C. Gujarat D. Karnataka

303. The Geological Survey of India (GSI) has discovered gold deposits estimated to be around 3,000 tonnes in which district of Uttar Pradesh?
A. Azamgarh B. Hamirpur
C. Shravasti D. Sonbhadra

304. Which football Club has become the first Indian club to play in the AFC Champions League?
A. Jamshedpur FC B. FC Goa
C. Chennaiyin FC D. Bengaluru FC

305. Which town has become the first 'zero waste town' of Assam?
A. Hamren B. Maibang
C. Chapar D. Titabor

306. Which state government will provide free spectacles to all school students aged between 6-18 years?
A. Gujarat B. Rajasthan
C. Maharashtra D. Madhya Pradesh

307. Defence Minister Rajnath Singh recently laid the foundation stone of Thal Sena Bhawan in which Cantt?
A. Ambala B. Varanasi
C. Delhi D. Meerut

308. The country's first floating jetty was inaugurated on the banks of which river?
A. Sal B. Krishna
C. Damodar D. Mandovi

309. Cyrus Poonawalla, Krishna Ella and Suchitra Ella were awarded Padma Bhushan on 73rd Republic Day 2022. They are:
A. Frontline doctors fighting against Corona pandemic
B. Non Resident Indians
C. The heads of India's two biggest Covid-19 vaccine maker
D. Scientists

310. The 3rd edition of Chitra Bharati Film Festival was held in which city?
A. New Delhi B. Indore
C. Ahmedabad D. Raipur

ANSWERS

1	2	3	4	5	6	7	8	9	10
D	C	B	D	B	B	C	D	A	D
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
D	B	A	A	D	A	A	A	B	A
21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
B	A	D	B	A	A	D	A	C	A
31	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
D	B	A	A	C	B	C	D	B	A
41	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**
A	B	A	A	D	B	A	C	A	B
51	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**
A	B	D	A	A	A	C	A	A	C
61	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**	**70**
B	D	A	D	A	A	A	B	C	A
71	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**	**80**
B	C	A	C	C	B	A	C	A	A
81	**82**	**83**	**84**	**85**	**86**	**87**	**88**	**89**	**90**
A	B	A	A	B	A	D	A	C	D

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91	92	93	94	95	96	97	98	99	100
C	B	A	B	D	A	D	C	D	D
101	**102**	**103**	**104**	**105**	**106**	**107**	**108**	**109**	**110**
B	C	A	B	A	B	B	B	A	C
111	**112**	**113**	**114**	**115**	**116**	**117**	**118**	**119**	**120**
C, D	C	C	D	A	D	A	C	A	A
121	**122**	**123**	**124**	**125**	**126**	**127**	**128**	**129**	**130**
A	B	C	C	C	A	C	A	B	A
131	**132**	**133**	**134**	**135**	**136**	**137**	**138**	**139**	**140**
B	D	A	B	B	A	D	C	C	D
141	**142**	**143**	**144**	**145**	**146**	**147**	**148**	**149**	**150**
A	D	A	C	B	A	A	B	A	B
151	**152**	**153**	**154**	**155**	**156**	**157**	**158**	**159**	**160**
D	A	A	D	D	C	A	D	D	A
161	**162**	**163**	**164**	**165**	**166**	**167**	**168**	**169**	**170**
A	B	A	C	B	C	C	D	C	D
171	**172**	**173**	**174**	**175**	**176**	**177**	**178**	**179**	**180**
D	B	A	B	C	D	C	B	B	A
181	**182**	**183**	**184**	**185**	**186**	**187**	**188**	**189**	**190**
A	A	C	C	B	A	A	D	D	A
191	**192**	**193**	**194**	**195**	**196**	**197**	**198**	**199**	**200**
A	B	D	B	C	A	B	B	C	B
201	**202**	**203**	**204**	**205**	**206**	**207**	**208**	**209**	**210**
D	D	C	B	A	D	A	A	C	C
211	**212**	**213**	**214**	**215**	**216**	**217**	**218**	**219**	**220**
D	B	D	D	B	A	C	B	D	C
221	**222**	**223**	**224**	**225**	**226**	**227**	**228**	**229**	**230**
A	C	A	B	B	D	A	C	D	C
231	**232**	**233**	**234**	**235**	**236**	**237**	**238**	**239**	**240**
C	A	A	D	B	C	A	A	D	A
241	**242**	**243**	**244**	**245**	**246**	**247**	**248**	**249**	**250**
C	D	A	D	C	B	B	C	C	B
251	**252**	**253**	**254**	**255**	**256**	**257**	**258**	**259**	**260**
D	D	A	C	D	D	B	C	A	B
261	**262**	**263**	**264**	**265**	**266**	**267**	**268**	**269**	**270**
C	B	B	A	A	D	A	A	B	D
271	**272**	**273**	**274**	**275**	**276**	**277**	**278**	**279**	**280**
D	C	D	C	B	D	C	A	A	C
281	**282**	**283**	**284**	**285**	**286**	**287**	**288**	**289**	**290**
D	D	B	D	A	C	B	A	C	C
291	**292**	**293**	**294**	**295**	**296**	**297**	**298**	**299**	**300**
B	C	A	D	B	D	C	B	A	C
301	**302**	**303**	**304**	**305**	**306**	**307**	**308**	**309**	**310**
A	B	D	B	D	C	C	D	C	C

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